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STEEL FOR ELECTRIC MACHINERY.

While homogeneous iron under the name of cast steel has come much in use among larger manufacturers of electrical machinery, yet little has been written on the subject, and the definite information given in another column will be found of timely value. Perhaps one reason why its use has not become more general is on account of the misleading name applied to the material. The property of temper is so bound up with the name of steel that it seemed paradoxical that it could be used for a purpose demanding, above everything else, the absence of that property. The name is actually a misnomer, as the material possesses only one property of cast steel—that of being homogeneous—and it should be called homogeneous iron. Cast iron, were it not for the significance already attached to the term, would be still better, but by the addition of "homogeneous," ambiguity would be avoided and a source of much misconception removed. An attempt in other branches of manufacture has been made to apply the correct name, and thus put an end to a wrong practice, which, in the early days of the use of the material for shipbuilding and structural work, was probably deliberately adopted to take advantage of the popular estimation in which the qualities of real steel were held.

MR. PREECE ON CIVIL SERVICE REFORM.

Those who advocate the government ownership of telegraphs in the United States will do well to carefully read the remarks of Mr. Preece in another column upon this subject. It is not too much to say that he is the one most competent in the world to speak on the question, and but little comfort can be drawn from his remarks, notwithstanding the intrinsic advantage which he shows may accompany government ownership—under proper civil service rules. The lesson conveyed may be a useful one if the advocates of government ownership will follow the inference that the first stage is the reformation of our civil service. By first devoting their energies to this, any considerable success they meet may have a general beneficial effect even greater than that anticipated from the accomplishment of their ultimate object. While we do not think our readers will entirely agree with Mr. Preece in his comparisons between the English and our own telegraphic service, yet those who believe in civil service reform will feel under obligations for the weight of his argument in its favor, which has also an indirect application to the subject of municipal ownership of lighting plants.

SUSTAINING THE EDISON LAMP PATENT.

The decisions favorable to the Edison lamp patents rendered last week in the Davis and Novak cases would seem to imply that as far as the New York and New England Federal Court Circuits are concerned, there is little chance of any other action on their part. The decision in the Novak case was rendered on Judge Shipman's opinion, and in the absence of an opinion from the full bench we are left in darkness as to the reasons of the court for not giving any weight to Judge Rick's recent opinion, which formed part of the Novak argument, as well as to their opinion in regard to the contention of the complainant's counsel that the carbon filament is Edison's invention, and that the removal of occluded gases is not a necessary part of the Edison patent. There are two important issues yet re-

maining for final decision in this celebrated series of cases—the Goebel and Buckeye suits—which will probably end the most sensational patent litigation on record, unless the New York Federal Court of Appeals in March reverses the decisions of the lower courts in the Bate refrigerator case. Should this be done, which seems to be not at all probable, the new lease of life given to the Edison patent would undoubtedly also renew the energy of its opponents.

LONG-DISTANCE TELEPHONY.

The article by Mr. Kennelly in another column will be found a most important contribution to telephony, not only on account of the practical deductions made, but also as showing how, by the choice of proper methods, a subject may be simplified which has heretofore been thought to be almost beyond the reach of ordinary mathematical processes. A comparison of the manner in which the same subject is treated by Heaviside will at once show the beauty and relative simplicity of the graphical method developed by Mr. Kennelly as applied to involved problems of this character, and which places within the reach of the practical man subjects heretofore only dealt with for the benefit of the chosen few who could understand the special mathematical processes employed. One result of the deduction is to again show the empirical character of the so-called KR law, which assumed that the amplitude of the received current varied inversely as the square of the length of the line, whereas it is shown that for lines of the length treated it varies inversely as the hyperbolic sine of a fraction of the length, and that beyond a certain point the values given by the alleged KR law are absurd. While it is true that actual telephonic currents are quite different from the simple harmonic form here treated, yet by the selection of proper mean values by experiment and the exercise of good judgment there is no reason why the same method should not be applied in dealing with the problems encountered in practical telephony. A most promising field is thus opened up, which, as pointed out in the concluding paragraph of the article, includes other branches than that of telephony.

THE SUPREME COURT AND PATENTS.

A recent decision handed down by the United States Supreme Court will probably have a revolutionary effect on patent procedure, and may affect the validity of some important patents. The gist of the decision is that when an inventor has a patent the subject matter whereof is disclosed in an earlier patent, and such earlier patent also has claims pertaining to the same subject matter, even though the two sets of claims may differ in breadth, the later patent is void. In order that the later patent may be valid the two sets of claims must apply to things that are physically different, such as separable and independent parts of the same machine. The decision, in other words, is a reaffirmation of the established doctrine that two patents cannot be issued for the same invention, but in terms so strict as to greatly affect previous practice. It does not seem that the decision has any bearing in regard to inventions by independent inventors, but refers only to separate applications of, or two or more patents already issued to, the same inventor. The effect of the decision will be good as far as it relates to basing separate patents upon hair-splitting distinctions, and stopping what had already come to be considered irregular practice in regard to divisional applications. In these respects it will probably bear some wholesome fruit, though at the same time it may work hardship to bona fide inventors misled by a prevailing practice. Those most competent to speak on the subject are averse to giving any definite opinion in regard to actual scope of the decision, owing to an apparently unusual use of terms that have a settled significance in patent law, and its definite significance will therefore have to await interpretation by the courts in cases which no doubt will be soon brought up.

THE EDUCATION OF ENGINEERS.

During the last year the subject of the education of engineers has been referred to frequently in our columns, and in his recent presidential address before the English Institution of Electrical Engineers Mr. Alexander Siemens, in his remarks on that subject, strongly confirms the views we have here expressed. Referring to the fashion of deprecating the study of dead languages, he feels certain that the attack is from quarters where the mental training which the study of these languages entails is not appreciated at its right value. After the mental powers have been thus prepared, he adds, it is of no great consequence whether most of the details of school teaching are forgotten or not, as the essential point is that the student should have acquired a good method of learning, so as to assimilate to the best advantage the course of training he afterward attends. He states that while preliminary teaching should have a general character, and embrace chiefly subjects that ought to be known to all classes, at college the various professions are differentiated, and in each branch the students learn the general principles that ought to govern them in their future career. "Formerly it was possible to let the course of scientific studies embrace all that was known in any particular branch; in fact, the general principles and the interdependence of the various branches were not, and partly are not yet, properly understood. To attempt a similar course at the present time is simply impossible, and the danger that has to be avoided in our scientific colleges is the tendency to teach our profession too much in detail. Besides overwhelming the professors with work, such a course is apt to create in the students the conviction that on leaving college with a first-class certificate they know all that can possibly be known, and that anything that does not fit in with the theory of their pet professor must necessarily be condemned." Mr. Siemens concludes that it is highly desirable that the teaching at engineering colleges should be confined to general principles as far as the applications of science are concerned, and that the student should become thoroughly well acquainted with the mental tools that are used in scientific investigations, such as mathematics, the general principles of chemistry, and of the branches of natural philosophy, and be trained afterward in practical work, when he has time to select what special branch of the profession he wishes to devote his life to.

Calculating the Resistance of Wires for Alternating Currents.

Our attention has been called by Mr. Horatio A. Foster to an error in a table published on page 114 in the issue of Jan. 27; the last number in the first column, namely, 137,958,900 should read 151,909,800.

"Nothing to be Learned From Americans."

Mr. Wiliam H. Preece, of London, in a recent paper, describing his visit to the United States, refers to his former visit in 1877, stating that the results were the introduction in England "of the telephone, the practical application of quadruplex working, the adoption of sound reading in our telegraph offices, the disappearance of the Morse recorder and the more general assimilation of the methods of working in the two countries"; the chief result of his second trip, in 1884, "was the introduction of the multiplex system of working by Mr. Delany, now so much in use amongst us, and doing splendid service in many of our chief towns." Anything else? Yet, some Englishmen claim that there is "nothing to be learned from Americans"!

Multi-Frequency Machines.

BY E. ARNOLD.

In The Electrical World for Jan. 6, 1894, page 21, Lieutenant F. Jarvis Patten publishes, as his own invention, a sketch of a multi-frequency machine. This gives me occasion to state that in the "Electrotechnische Zeitschrift" of Jan. 20, 1893, I have shown exactly the same arrangement. The Electrical World took notice of this under the title "Doubling the Frequency," in the issue of Feb. 11, 1893, page 109.

In the aforementioned article I have first proven analytically that when we move a circuit, closed on itself, in a periodic magnetic field, synchronously with the pulsations of the field, a current of double the number of alternations will be induced. Furthermore, I have there said: "If we fasten two alternating-current machines with the same number of poles and windings, on a common shaft, in such a manner that the field of the second one is excited by the current of the first, the second machine will generate a current of double the number of alternations."

The multi-frequency machine shown by Lieutenant F. J. Patten is only a copy of this design. I have also had in mind the employment of this apparatus in the generation of Tesla currents, but the great losses through hysteresis and eddy currents prevent the use of the present alternating-current machines with low frequencies. In order to obtain a useful, working alternator on the principles laid down by me, the construction must be suited to the changed conditions. The solution of this problem is conceivable, and I will come back to it at an opportune occasion.

Oerlikon, Jan. 18, 1894.

Air-Core Transformers.

BY E R. CARICHOFF.

In your issue of last week I observe a joint communication on "Air-Core Transformers" from Messrs. Frederick Bedell and Albert C. Crehore, in which those gentlemen, referring to the fact that Mr. Remington, in a paper read before the Physical Society, Oct. 27, 1893, "called attention to the case in which the primary current of a transformer falls off when the secondary is closed," point out that they noted the same phenomenon last spring, and called attention to it in The Electrical World, June 17, 1893.

I wish in turn to assure Messrs. Bedell and Crehore, as they have done Mr. Remington, that the same phenomenon was noted by me in the fall of 1892 at Johns Hopkins University, while drawing A. C. curves with the Duncan-Carichoff electro dynamometers, and I should not be surprised if some one can assure me that the phenomenon was noted even earlier than that date.

Edison Lamp Suits.

A decision in the appeal of the Davis Electrical Company, of Springfield, Mass., against the decision of Judge Colt, enjoining it from repairing Edison incandescent lamps, has been rendered by the Appellate Court in favor of the General Electric Company.

The Circuit Court of Appeals, sitting at New York, has affirmed the decision of Judge Shipman against the Waring Electric Company in the Novak lamp case. Unless by agreement of counsel on both sides the order will not be handed down until March 19.

The Universal Electric Company, of Cleveland, Ohio, on Feb. 12 submitted affidavits and an argument to Judge Ricks asking that his decision affecting the Buckeye Company be extended to it. Decision was reserved.

Chemistry of the Air.

Our contemporary, London "Lightning," Jan. 11, contains a short description of Prof. Dewar's recent Royal Institute lectures, from which we take the following: "The powerful oxidizing power of ozone was shown by its rapidly piercing a piece of india rubber. The absorption of oxygen by molten silver, which gives it off again on cooling, was next shown, and the lecture concluded by an exhibition of the absorption bands when a beam of light passed through a tube containing air at a pressure of 100 atmospheres, proving that air is colored. The separate steps to liquid air were then explained—ether, solid carbon, dioxide, liquid nitrous acid, liquid ethylene, which last is not a little dangerous, as it readily takes fire, though so cold that when thrown into water it forms cups of ice, in which it floats. The vapor of some drops so treated was set on fire in illustration." A flask of liquid oxygen was brought in boiling away at — 180° C. It was a pale blue color, showed the absorption bands and was slightly cloudy with solid impurities, such as dust, carbon dioxide, water and ammonia—all solids at this temperature. He explained the critical temperature of a body which below that temperature can exist either in a liquid or a gaseous state. "He illustrated this with a tube of carbon dioxide, which he first raised above the critical temperature and then cooled until the liquid began to appear at the top of the tube. He said he had been asked the cost of liquid air; he did not dare to say, lest the treasurer of the institute might be present and the proceedings be put a stop to; but he showed views of apparatus required, described its use, and left his audience to draw their own conclusions. Other striking experiments followed in rapid succession—a snowstorm of carbon dioxide in the upper part of a tube of boiling oxygen—the formation of a mirror of solid mercury on a Torricellian vacuum tube by cooling the glass with cotton dipped in liquid oxygen—liquid air and liquid oxygen clinging like iron filings to the poles of a magnet—a demonstration that at very low temperatures oxygen would not combine with the most oxidizable substances, nor support combustion. But perhaps the most striking of all was the condensation of the air of the room on the surface of a tube of liquid oxygen cooled by evaporation to — 205° C., so that it fell from the end of the tube in drops."

The National Electric Light Association.

Mr. C. O. Baker, master of transportation, has issued the following circular:

The various passenger associations have granted a rate of a fare and one-third for the round trip from all points east of Chicago, Burlington and Peoria and the Mississippi River to Washington, D. C. Negotations are now pending with the Western Traffic Association for members in that territory to secure this rate. Ask the ticket agent from whom you purchase your going ticket for Delegate Certificate to National Electric Light Association meeting, which, when properly filled in and certified at association headquarters in Washington, will entitle you to return for one-third the regular fare.

A special vestibuled train, composed of parlor cars, will leave via Royal Blue Line, foot of Liberty street, New York, at 1.20 P. M. Monday, 26th instant, and will leave Twenty-fourth and Chestnut streets, Philadelphia, at 3.20 P. M., arriving at Washington, D. C., 6.20 P. M. Seat checks for this train can be procured from the undersigned at $1.25 each, and railroad tickets from New York to Washington at $6.50 each. Railroad tickets can also be obtained at any Blue Line ticket office. Be sure you get a certificate when purchasing ticket. Please make checks payable to C. O. Baker, Jr.

Electrical Quackery.

In referring to the Harness "electric belt" advertisements, the London "Times" states that the so-called religious papers were the worst offenders in the matter of quack and fraudulent advertisements.

A Brief Review of the Faraday-Maxwell-Hertzian Epoch.—II.

BY M. I. PUPIN.

To sum up briefly: The most essential features of the science of electricity and magnetism during the epoch preceding Faraday may be described concisely as follows: The fundamental concepts in the science were the forces acting between electric and magnetic bodies. The fundamental laws were the laws of action of these forces; that is, mathematical statements expressing the relation between the intensity and direction of these forces and the distances between the acting bodies, including also quantities describing the intensity of the magnetic or electric states of these bodies, the so-called quantities of electricity, of magnetism and of current. These laws were Coulomb's laws of inverse square for electrified and magnetized particles, and Ampere's law of inverse square for elementary electrical currents. The striking similarity between these laws and Newton's law of universal gravitation made the problems in electricity and magnetism mathematically almost identical with those in geodynamics and celestial mechanics, hence whatever notions had gradually become attached to the idea of force of gravitation were necessarily introduced into the science of electricity and magnetism, and among them the belief in "direct action at a distance."

The opinion that this belief retarded the progress of the electrical science at the time is hardly justifiable. On the contrary, it may be said to have done considerable good, for it prevented useless speculation, and thus saved time for the work which produced most excellent results such as Ampere's, Green's and Poisson's beautiful and exceedingly useful theorems. The time for the discussion of this belief was not ripe until the science of electricity was enriched by Faraday's immortal discoveries. They form the physical basis of our belief that electrical and magnetic actions between bodies are transmitted by the intervening medium. More than that, they were the very seed which, falling upon the virgin soil of an unprejudiced mind, sprang forth naturally in the luxuriant growth of such a belief. For who can see a current generated in a neutral conductor by the motion of a magnet, or the capacity of a condenser changed by the change of the dielectric substance, or a substance paramagnetic in air become diamagnetic when immersed in a more strongly paramagnetic iron salt solution, or the electromagnetic induction intensified a thousand fold by the introduction of iron between inductively related circuits; who can see all these revelations of Faraday's profound researches and still believe that they suggest nothing beyond direct action at a distance? Surely, not a physicist like Faraday, whose wonderful faculty of keen observation was equalled, if not even surpassed, by great powers of poetic intuition. So deeply was he convinced by these phenomena of the importance which the medium surrounding electrical and magnetic bodies plays in the mutual action of these bodies, that he proceeded to draw a map describing in detail the function which the medium performs in these actions. We thus obtained Faraday's map of the field of electric and of magnetic forces. I now quote from Maxwell:* "For instance, Faraday, in his mind's eye, saw lines of force traversing space where the mathematicians saw centres of force attracting at a distance; Faraday saw a medium where they saw nothing but distance; Faraday sought the seat of phenomena in real actions going on in the medium; they were satisfied that they had found it in a power of action at a distance impressed on the electric fluids." These few words, coming from a man who was first to see clearly the bearing of Faraday's immortal work, suffice to give a faithful picture of the ideas which guided the great master of modern electrical research in his profound investigations.

A few words must be added here to show briefly the relation between Faraday's work and this picture, which Maxwell gave us, of Faraday's guiding ideas.

Faraday's discoveries are known to-day, especially among electrical engineers, chiefly through the technical applications of the fundamental principles which were first established by these discoveries. The dynamo and the motor, the telegraph and the telephone, the induction coil and the modern transformer, all these great inventions; in fact, the whole science of electromagnetism and electrodynamics, both pure and applied, are only single illustrations of the wide range which is covered by these discoveries. But it is no more than just to mention here that in the region of the electrical science just mentioned, namely, in electromagnetism and electrodynamics, a very fair, if not an equal, share of the glory of original discovery belongs to our own countryman, illustrious Joseph Henry.

Faraday can well afford to share these honors with so great a physicist. For it adds to his greatness to have it recorded in the annals of science that the supreme effort in the life-work of so great a physicist as Joseph Henry was the first step only in the long series of Faraday's far-reaching discoveries. A comparison of the flight of an eagle to that of a falcon suggests itself irresistibly to my mind when I compare the researches of these two great investigators. The falcon eye of Joseph Henry scanned carefully from its lofty height the enchanting view of the newly discovered regions, the regions of electromagnetic induction. Faraday's mind is carried, as it were, by the powerful wings of the royal bird to heights that are sublime. *But what is it that calls Faraday away from and far above the lofty heights of Joseph Henry?* This is the question which presents itself to every thoughtful student of Faraday's "Experimental Researches." For who does not feel that the pleasure one gets from reading Faraday's masterly story of his discovery of electromagnetic induction given in the first part of volume I. of his "Researches" ends much too soon? I even venture to suggest that many a one among these students of Faraday, especially those whose taste runs more in the direction of estimating the value of a new discovery by the immediate practical application to which it can be put, has undoubtedly bemoaned the fact that Faraday allowed himself to be drawn away so soon from his researches in electromagnetic induction to matters so abstract as electro-chemistry, electric discharges through gases, specific inductive capacity of dielectrics, magnecrystallic action, magnetic properties of flames and gases, action of magnetism on light, etc., etc., seem to be, in comparison to so eminently practical a subject as electromagnetic induction certainly is.

But a careful review of Faraday's long series of researches suggests to my mind a very intimate connection between the numerous and apparently independent parts of that long series. They are all just so many little streams which flow into the same main current of thought. It starts from the phenomena of electromagnetic induction. The tributary streams make it stronger and stronger. It grows wider and wider, and finally disappears in the dim regions, which, according to Faraday's visions, connect the phenomena of light, electricity and magnetism. The phenomena of electromagnetic induction inspired the prophetic mind of Faraday with the idea that there must be an invisible mechanism connecting material bodies, and that it is the activity of this mechanism which makes us cognizant of the existence of electric and magnetic forces. He gave expression to this inspired idea by introducing into his mode of thought and of description a new term, the term magnetic curves, or lines of magnetic forces. At first he gave us only their geometrical definition: "By magnetic curves," he added in a foot

*Treatise on Electricity and Magnetism, preface, volume I., page 10.

note, volume I., page 32, "I mean the lines of magnetic force, however modified by juxtaposition of poles, which would be depicted by iron filings; or those to which a very small magnetic needle would form a tangent." But the intimate connection between the phenomena of electromagnetic induction and these curves, or lines of magnetic force, convinced him that these curves are actual physical existences and not mere geometrical space relations, of which the iron filings give us a convenient material picture. He was aware that the nature of these new physical existences could not be revealed by a study of phenomena like those of electromagnetic induction as long as these phenomena could be observed in bodies of finite dimensions only. He saw that the road leading to the understanding of the lines of force was by way of the phenomena which can be traced with certainty to the ultimate elements of matter, to atoms and molecules. This was the voice which called Faraday away from the lofty heights of Joseph Henry and bade him rise higher and higher until he reached heights so sublime that only the wings of a genius like that of Maxwell could reach him. This is why Faraday's discoveries in electromagnetic induction led him into researches of what may be called the atomic and molecular region of the science of electricity. From this standpoint of view, the chronological order in which his researches in electro-chemistry, voltaic electricity, specific inductive capacity of dielectrics, disruptive discharges through gases, animal electricity, action of magnets on light, on metals and their compounds, on gases, on crystals, etc., etc., follow each other in rapid succession, appears natural. The numerous discoveries revealed by these profound researches encouraged the great discoverer that his work was in the right direction. With steady aim he forges ahead with giant strides. The most vigorous years of his life are consumed in gathering the vast amount of evidences with which to reveal before our eyes the physical nature of the lines of force, his first inspiration, and banish forever the old superstition of direct action at a distance. With renewed vigor he returns to this favorite subject toward the closing years of his life. His research "On the Lines of Magnetic Force; Their Definite Character; and Their Distribution Within a Magnet and Through Space" (Philosophical Transactions, 1852, page 1), given in the twenty-eighth series of his "Researches," mark the beginning of the last epoch in his great work. It prepares us to enter into the innermost thoughts of Faraday and see that inspiration and those visions which guided his steps for twenty years. The essays which now follow, "On the Lines of Magnetic Force," "On the Physical Character of the Lines of Magnetic Force," "On the Physical Lines of Magnetic Force," "Thoughts on Ray Vibrations," etc., are just like the glow of an approaching sunrise. The fairyland of Faraday's vision begins to appear clearer and clearer in this gently rising light, but, alas! the cloud of old age hides away the beauties of the sunrise itself.

A tower rising way above this cloud was needed. Faraday had collected the building material and he also prepared a rough sketch of the plan. It was reserved for Maxwell to raise the lofty edifice from which we first obtained a clearer view of the wonderland of Faraday's visions.

I cannot do better than close these few observations on the position which Faraday occupies in the epoch which closed with Hertz by quoting a beautiful passage from a lecture of this most worthy pupil of Faraday and Maxwell:* "Faraday heard of the belief that electrification puts something into a body, but he saw that the changes produced were all external and none internal. Faraday was taught that forces jump through space, but he saw that these forces were influenced in the highest degree by the substances which filled the space. Faraday read that electricities certainly existed, but that their forces were a disputed question, and yet he saw that these forces produced tangible effects, although he could not perceive anything of the electrifications themselves. Hence, in his conception, the state of these things became reversed. The electric and the magnetic forces appeared to him as existing, as real, as tangible; electricity and magnetism were things whose existence might be a disputed question. The lines of force, as he called the forces considered as independent entities, stood before his mind's eye as conditions in and of the space, as strains, as vortices, as fluxes, as something or other—he could not tell as what—but there they stood, inuenced each other, they pushed the bodies and they pulled them, and they continued from point to point, conveying impulses to each other. The objection that nothing but absolute rest was possible in empty space he met with questions: Is space really empty? Does not light itself compel us to assume it as filled? Could not the ether which conveys the waves of light become the seat of those changes which we recognize as electric and magnetic forces? Is it not even possible to imagine a relation between these changes and those waves of light? Why could not these waves of light be something like the oscillations of those lines of force?

"So far did Faraday reach in his conceptions and his surmises. He could not prove them. He busily searched for evidences. The connection between light, electricity and magnetism was the favorite subject of his research. The beautiful connection which he found was not the one for which he looked. * * * Only the highest old age put an end to his efforts."

(To be continued.)

*Hertz: Ueber die Beziehungen zwischen Licht und Electricitaet; a lecture delivered before the convention of German naturalists and physicians at Heidelberg in 1890. Published by Emil Strauss, Bonn.

The Niagara Falls Power Plant.

In a recent communication Mr. Charles Russell, of Philadelphia, Pa., expresses doubt as to the realization of all the hopes of those connected with the scheme for the transmission of power at Niagara Falls. As to transmitting power to Buffalo, the whole question, according to his idea, resolves itself into a difference of cost between running a water-power plant at Niagara and a steam plant at Buffalo. Admitting that there is an advantage of 25 per cent. in favor of the Niagara water-power plant, the additional cost of lines from Niagara to Buffalo and their maintenance, as well as the depreciation and interest on the same, will make it evident that there cannot be a great percentage in favor of Niagara, and as the distance increases the advantage decreases. Mr. Russell states that he has given the matter considerable attention and made various estimates, and that he fails to see such a glorious future as some have claimed for the Niagara Falls Power Company. He has great faith, however, in the success of the project in so far as it does mass the business together at the Niagara plant, and believes that Niagara's profit is in utilizing its power for manufacturing purposes on adjacent grounds.

At Last They Make a Beginning.

Our English contemporaries publish as a piece of news, to which they seem to attach some importance, that the first large electric motors for driving printing presses in London have recently been installed in the office of the "Pall Mall Gazette." The Electrical World was printed from presses driven by an electric motor in 1884, just ten years ago. And yet some Englishmen claim that there is "nothing to learn from Americans."

A Current Without a Difference in Potential.

BY PHILIP K. STERN.

In the matter of "Current Without Difference of Potential," a subject which appeared in The Electrical World of Jan. 27, page 110, and reappeared in the next issue, kindly permit me, through the medium of your columns, to ask the writer of the original item whether it is to be understood that the supposed charge is to be considered as resident on the conductor, i. e., the charges of the plus and minus values respectively on the opposite faces of the concentric cylinders, or are these values to be considered as a mere difference of potential in the dielectric medium intervening? The third paragraph has, apparently, the former meaning.

In any event, if a current is set up without a difference of potential existing between any two points in the conductor, I ask permission to state that the supposed current would not flow through the conductor between such points. Though choosing a point of reference in the dielectric medium, and an electrified particle located at a point on the ring having angular velocity, a current might be considered as flowing from the right or left of the point of reference, according to the direction of rotation. In this case there would be a difference of potential. According to Maxwell: "Two electrified particles having the same potential placed side by side, starting from a state of rest and set in motion with a positive acceleration, will mutually repel until they have attained a velocity equal to that of light, when their electrostatic repulsion would exactly balance their electromagnetic attraction; after this period, though they would still be at the same potential, they would attract mutually." There must certainly be a difference of potential; where is it? Is it not in the medium through which the charges are being conveyed, and may not this be due to a transverse strain on the luminiferous ether and positive or negative (from a point taken midway between the particles), in consequence of the resultants of the forces at work, viz., the resistance offered by the medium and the force which is overcoming the same?

Here we have come face to face with resistance in the nature of a velocity, and so in the case of the two concentric cylinders we must consider the velocity of the rotating cylinder in question. With a charge located at a point on its outer surface, or at a number of points, as a resistance; and as resistance is being overcome, work must be the result. Does this not define potential? Moreover, the term employed to electrically denote that which overcomes resistance is an electromotive force.

Are these not instances of differences of potential where work is being done between the points referred to? It would appear as though we might call this, as well as the work that can be done by virtue of the position of these points (electromotive force), a difference of potential.

Considerable gain might result in these investigations by directing our attention to the dielectric medium as the true cause of the phenomena.

I should like to ask Prof. Anthony to kindly inform me as to what direction the current might be expected to flow through the ring referred to without a difference of potential, or, as stated, "electrical potential." If there should be a difference of potential, or, potential other than electrical, as soon as we consider the question of there being electrical work done or electricity moved against resistance, why can we not consider this electrical potential?

(There is, to our knowledge, no original author of the note referred to, it being merely a summary of an informal discussion which we published, as it was sent to us, thinking the subject might be of interest to some of our readers. The publication of such reports does not, of course, necessarily imply any endorsement on the part of the editors of the opinions expressed. It seems evident from the original note that the charges are supposed to reside in the conductors and not in the dielectric. We might add here that we believe Prof. Rowland showed experimentally a number of years ago that a static charge in motion was the equivalent of a current. It has been suggested to us that a discussion of this subject may be found in J. J. Thomson's recent work.—Eds.)

Long-Distance Transmission with Alternating Currents.

BY FRANK C. PERKINS.

MOST interesting alternating-current plant has recently been installed at Schongeisung and Furstenfeld-Bruck, Germany, for the transmission of electricity for light and power.

This transmission plant was designed by Mr. Oscar von Miller, of Munchen. The general plan of the line and distribution of power is shown in Fig. 1. The generating station is situated at Schongeisung, a distance of seven kilometres from the centre of distribution of light and power at Furstenfeld-Bruck.

The single-phase alternating current was chosen for this plant, because it was thought to be the cheapest and surest

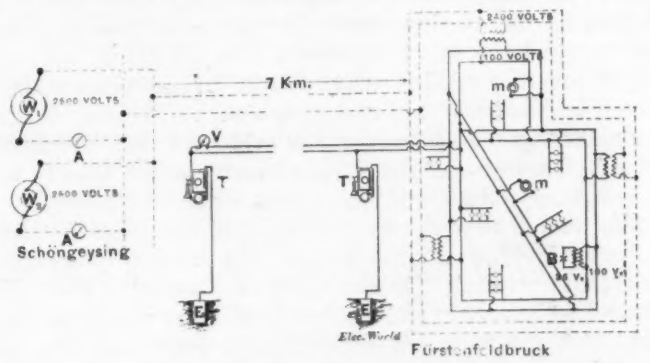


FIG. 1—GENERAL PLAN OF DISTRIBUTION.

method for the conditions presented. Two alternating-current dynamos (Fig. 2) of 2,600 volts each are connected in parallel, and the current is carried on two conductors to a closed ring distribution, the dotted lines in Fig. 1 representing the high potential circuit and the heavy lines the sec-

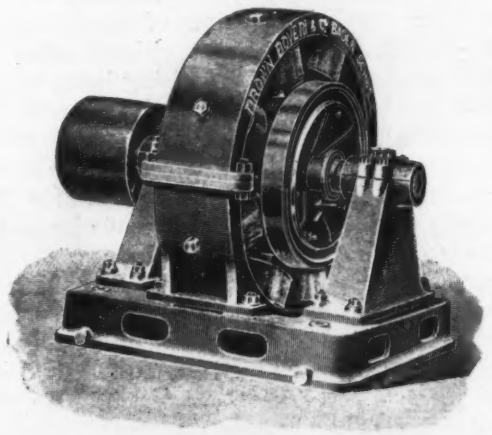


FIG. 2.—SINGLE-PHASED DYNAMO.

ondary, or low potential circuit. Transformers are connected at various points, reducing the voltage from 2,400 volts to 100 volts. Each arc lamp on the secondary circuit has a small transformer in circuit, reducing the voltage from

100 to 36 volts, thus avoiding the use of resistance coils for the arc lamps.

A novel feature connected with this plant is the use of a potential indicator circuit for a telephone line. A voltmeter

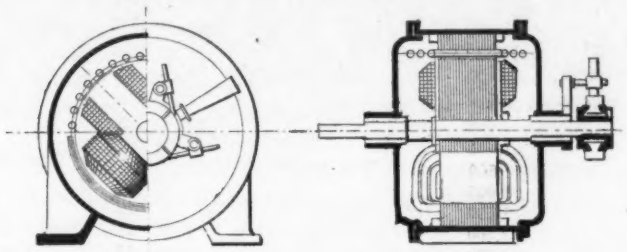


FIG. 4.—SECTIONAL VIEWS OF SINGLE-PHASED MOTOR.

in the generating station is connected by a line with the secondary lighting circuit at Furstenfeld-Bruck to show the potential at the centre of distribution. One of the conductors of this circuit is connected, through telephonic instruments, to the ground; and it is said the line gives good service.

The turbine and generator plant (see Fig. 3) utilizes

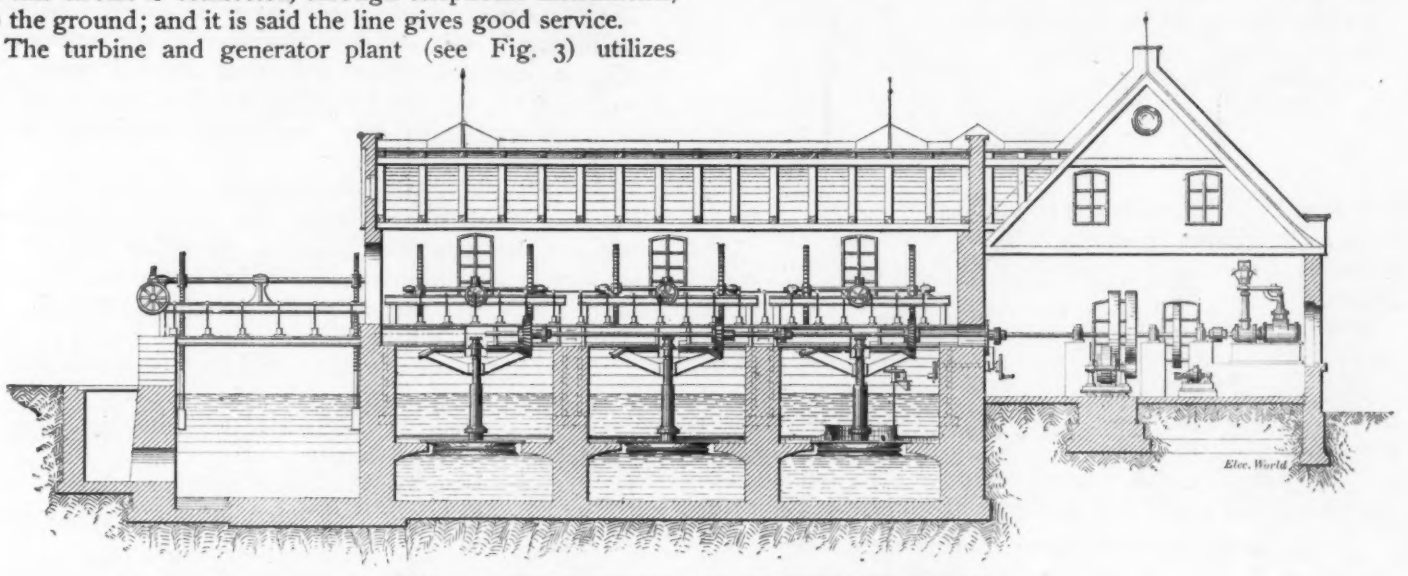


FIG. 3.—THE TURBINE AND GENERATOR PLANT.

the water of the River Amper. When the plant is completed three turbines and three dynamos are to be used. Up to the present time but two turbines have been installed, each having a capacity of 68 h. p. The turbines and regulating apparatus were furnished by Schelson & Issmayer, of Munchen,

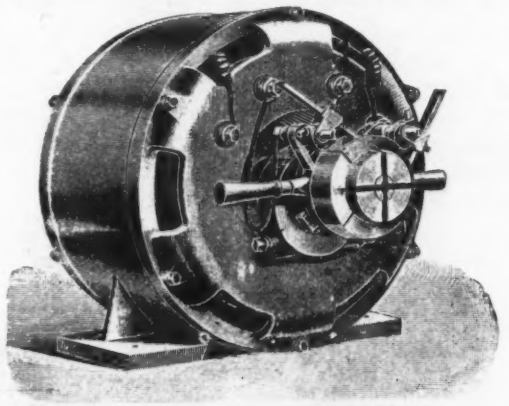


FIG. 5.—SINGLE-PHASED MOTOR.

and Briegleb, Hansen & Co., of Gotha. The turbine shafts revolve vertically and are geared to a line shaft, to which the dynamos are belted. The alternating-current generators, transformers and motors were furnished by the firm of Brown, Boveri & Co., of Baden, and they are exceedingly simple in construction. The design of the motors may be seen in Figs. 4 and 5.

The main line from Schongeisung to Furstenfeld-Bruck consists of two bare wires six millimetres in diameter, mounted upon the usual porcelain insulators. The loss on the line and at the transformers amounts to 17 1-2 per cent. It was found to be necessary to use an overhead construction for the distribution instead of underground cables, as the former method averages about 20 marks per house and the latter method about 200 marks per house, or ten times as much.

In giving the total energy received at Furstenfeld-Bruck the energy necessary for a 16-candle power lamp has been used as a unit.

Energy at Schongeisung—
- 2 machines, 120 h. p.....1,580 16-c. p. lamps
- 3 machines, 180 h. p.....2,370 16-c. p. lamps

Seventeen and one-half per cent. loss on line and transformers—
- 2 machines.....280 16-c. p. lamps
- 3 machines.....420 16-c. p. lamps

Net energy at Furstenfeld-Bruck—
- 2 machines.....1,300 16-c. p. lamps
- 3 machines.....1,950 16-c. p. lamps

The rate charged per lamp hour at Furstenfeld-Bruck is 8 pfennig (one-quarter cent), where 2,500 lamp hours are used annually, shutting off at 11 o'clock.

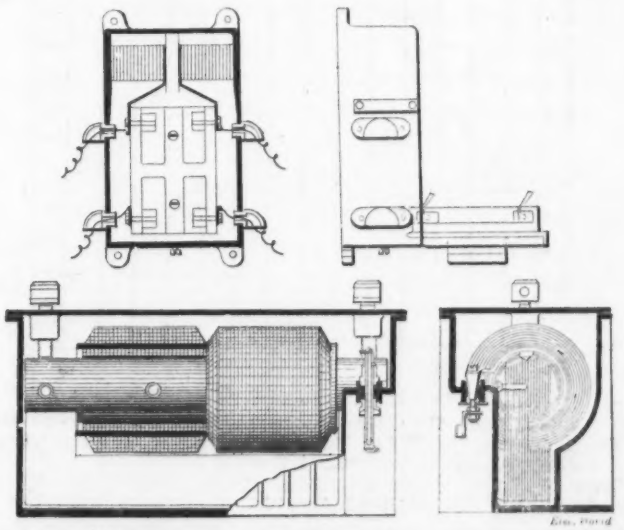


FIG. 6.—THE TRANSFORMER.

The transformers (Fig. 6) consist of an iron frame, on which the primary and secondary coils are wound. These are placed in cast-iron cases filled with oil.

A recent communication received from Mr. Oscar von Miller states that the plant is giving excellent satisfaction.

A Contribution to the Theory of Telephony.

BY A. E. KENNELLY.

THE theory of the transmission of telephonic current waves is complex to the degree that the wave character of their generated E. M. F. must be, in order to follow and even partly conserve the highly composite character of vocal vibrations in air. Nevertheless, the theory of transmitting sinusoidal current waves of any single frequency within telephonic range is simple, and with judiciously selected values of frequency and amplitude, the application of this elementary theory may, with due reservation, be of practical value.

It is the object of this article to develop the theory of simple harmonic telephony in its simplest form, and to point out a few of its consequences.

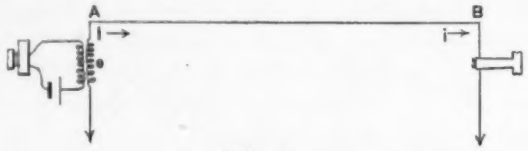


FIG. 1.

A B in Fig. 1 represents a single line of copper wire *L* miles or kilometres in length, with an induction coil transmitter at *A*, a receiving telephone at *B*, and ground return circuit.

If we assume that a pure musical note of some standard frequency is sung steadily before the transmitter at *A*, producing a steady sinusoidal current in the primary circuit of the coil, a sinusoidal E. M. F. will be generated in the secondary winding. The effective E. M. F. delivered at the terminal *A* will, however, depend upon the load, namely, the impedance of the line and receiving instrument. The manner in which the voltage of delivery varies with the load may be observed by experimentally substituting for the line an adjustable non-inductive resistance, and measuring the E. M.F. at terminals with a delicate electrostatic voltmeter as this resistance is changed. The following table and the curve (Fig. 2) give the result of a series of observations made with a small telephone induction coil of European construction, having a primary of 1.21 *O* and 0.0091 *H*, a secondary of 393 *O* and 1.13 *H*, and a mutual inductance of 0.12 *H*, with two storage cells in the primary circuit, and the note "middle C" of 256 ~ sustained in a moderately loud voice before the transmitter. The readings were too variable to admit of a high degree of accuracy, but the curve fairly represents the terminal E. M. F. produced by the transmitting apparatus under those conditions for any external impedance up to 7,500 ohms.*

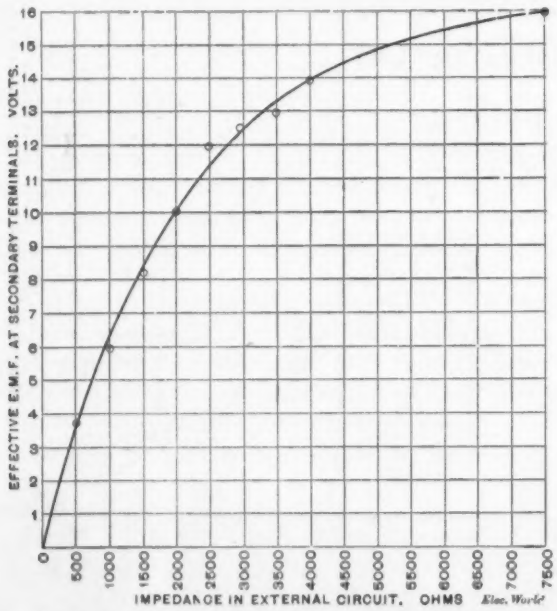


FIG. 2.—CURVE REPRESENTING THE OBSERVED RELATION OF EFFECTIVE TERMINAL E. M. F. TO LOAD IN A TELEPHONE INDUCTION COIL.

Ext. Res.	Effective Volts at Terminals.
500	3.75
1,000	6.
1,500	8.25
2,000	10.
2,500	12.
3,000	12.5
3,500	13.
4,000	14.
7,500	16.

Returning then to Fig. 1, the effective voltage at the terminal *A* is experimentally determinable, when the impedance of the line and receiving instrument can be assigned.

The distance at which simple harmonic sound waves will be recognizable with sufficient clearness for the purposes of intelligent communication will then depend upon the strength of the current reaching the telephone at *B*, the usual amount of "cross-talk," and other disturbances, being taken into consideration.

The problem may therefore be stated as follows:

For any given homogeneous line of known resistance, inductance, leakage, and capacity, grounding through apparatus of known impedance, to find the total impedance as presented at *A*, and thence having determined the effective pressure at *A*, to find the current strength that will reach *B*. Simple harmonic telephony will then be practicable or not, according as this current strength exceeds or falls short of some experimentally determined and limiting value, at the standard frequency adopted.

Let *L* be the length of the line in miles or kilometres.

r be its conductor resistance in ohms per mile or kilometre.

l be its inductance in henrys per mile or kilometre.

c be its capacity in farads per mile or kilometre.

g be its leakage conductance in mhos per mile or kilometre.

ω be $2\pi \times$ the frequency.

j be $\sqrt{-1}$.

e be the effective terminal voltage at *A*.

i be the effective current strength through *B*, in amperes.

I be the effective current strength at *A* in amperes.

J be the vector impedance of the apparatus at *B*.

J will usually have the form $(R_T + j L_T \omega)$, where R_T and L_T are the resistance and inductance of the apparatus, which is shown in Fig. 1 as a telephone.

Then it can be readily shown that

$$I = \frac{e}{y}\left(\frac{y \cosh Lz + J \sinh Lz}{y \sinh Lz + J \cosh Lz}\right), \qquad (1)$$

and

$$i = \frac{e}{y \sinh Lz + J \cosh Lz}, \qquad (2)$$

where

$$z = \sqrt{(r + jl\omega)(g + jc\omega)} \text{ and } y = \sqrt{\frac{r + jl\omega}{g + jc\omega}}. \qquad (3)$$

These equations give the magnitude and phase of the currents at the receiving and transmitting ends of the line,

*It is not, of course, justifiable to assume that because these values of E. M. F. were observed with non-inductive resistance, they would be exactly reproduced with impedances of equal numerical value. The angle of lead or lag in the impedance of a telephone line seldom equals 30 degrees, however, and experiment appears to show that the discrepancy is not worth considering in consequence.

the quotient e/I in (1) being of course the impedance of the line A, which being computed gives both e and I, whence equation (2) determines the serviceability of the line.

These equations involve plane vectors, of which the rules for treatment are given in The Electrical World for Jan. 6, 1894, volume XXIII., No. 1, page 18. The equations may, however, be further simplified when dealing with electrically long lines; that is to say, lines approaching the limitations of transmission, for in such cases the influence of impedance in the receiving apparatus usually ceases to be dominant upon the circuit, and we may make $J = 0$, while, since the vector $L\,z$ is then sure to be more than two units in length, its hyperbolic tangent in (1) will be practically unity, so that for long lines, here considered, our equations become:

$$I = \frac{e}{y \tanh L z} = \frac{e}{y}, \qquad (4)$$

and

$$i = \frac{e}{y \sinh L z}, \qquad (5)$$

But long distance telephony employs metallic circuits, such as is represented in Fig. 3 with an effective E. M. F. of E volts at A.

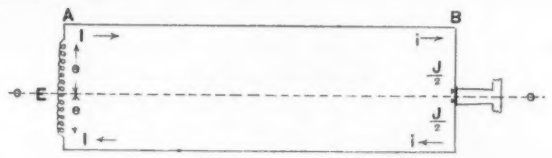


FIG. 3.

The line $O\,O$ divides this circuit into two symmetrical halves, each as though employing ground return, and with half the E. M. F. at A, half the impedance in the apparatus at B, and twice the capacity allowed to each wire that is measured between them when insulated from the ground and from each other. In equation (1) we therefore insert half the vector quantity J, and the quotient e/I then gives the impedance of either half of the complete circuit. Twice this result being the impedance of the loop at A, E is obtained from the experimental data, and e or half of E inserted in (2) or (5) supplies the strength of received current i.

We may now consider some examples of these formulae. First case: Two parallel overhead wires, each 950 miles long, of hard drawn copper 0.165 inches (0.419 centimetre) in diameter, are supported on poles at an interaxial distance of 9 inches (22.9 centimetres), no other wires being in their vicinity. Then each may have per mile a resistance of 2.2 ohms, a capacity of 0.009525×10^{-6} farad, an inductance of 0.00159 henry, and a leakage conductance quite negligible.

Then if the simple harmonic standard frequency is 238.7 $\sim$, making $\omega = 1500$, we have

$$L = 950.$$
$$r = 2.2.$$
$$l = 1.59 \times 10^{-3} \therefore l\omega = 2.385.$$
Doubled $c = 1.9 \times 10^{-8} \therefore c\omega = 2.85 \times 10^{-5}$.
$$g = 0.$$

Therefore, as shown in Fig. 4, $z^2 = 9.248 \times 10^{-5} \angle 137° 18'$, $z = 9.617 \times 10^{-3} \angle 68° 39'$, $y^2 = 1.1385 \times 10^5 \angle 42° 42'$, $y = 3.374 \times 10^2 \angle 21° 21'$.

It is to be observed that twice the actual value of c has to be allowed, owing to considering the lines as being operated independently with ground return. Similar remarks apply to the case on page 19, vol. XXIII. The impedance y of one line is thus 337 ohms, and 674 ohms is the impedance of the loop at A. By reference to Fig. 1 it appears that the terminal pressure which the transmitter would support on this circuit would be 4.6 volts, or 2.3 volts on each wire. Fig. 5 shows $L\,z$, which is L times the length of the vector z, and with components a and $j\,b$ of 3.326 and 8.508 respectively. The hyperbolic sine may be fully

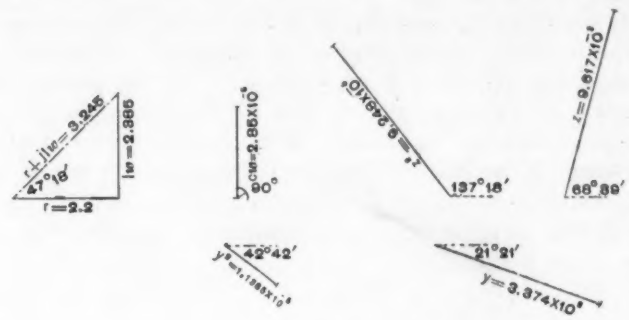


FIG. 4.

worked out as indicated on page 18, vol. XXIII., but whenever, as in this instance, the horizontal component a is greater than 2, the maximum possible error in the numerical value of sinh $L\,z$ made by ignoring the vertical component is 3.5 per cent., and when a is greater than 2.5, 1.25 per cent.; rapidly dwindling. We may, therefore, when considering long lines, write equation (5) as

$$i = \frac{e}{y \sinh a}. \qquad (6)$$

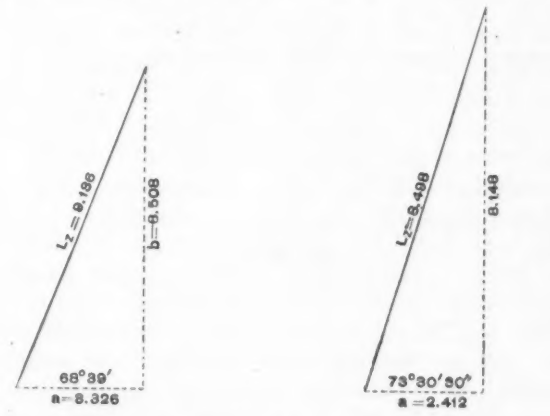
Here, see Fig. 8,

$$\sinh a = 13.9, \text{ and } i = \frac{2.3}{337 \times 13.9} = 0.0004905 \text{ ampere.}$$

This is the current strength we should expect at B.*

Second case: The same wires separated to an interaxial distance of 72″ (183 centimetres), the inductance per mile of each is now 0.002259 H, and the capacity of each to each insulated 0.006604×10^{-6} farad. Thus $l\omega = 3.389$, and doubled $c\omega = 1.981 \times 10^{-5}$.

Fig. 5 represents the corresponding steps in computation



FIGS. 5 AND 7.

$z^2 = 8.00 \times 10^{-5} \angle 147° 1'$, $z = 8.944 \times 10^{-3} \angle 73° 30' 30''$, $Lz = 8.498 \angle 73° 30' 30''$, $y^2 = 2.041 \times 10^5 \angle 32° 59'$, $y = 4.518 \times 10^2 \angle 16° 29' 30''$.

The impedance of the loop at A or $2y$ is now 904 ohms, at which the terminal pressure is $E = 6$ volts, or 3 to each wire. Entering equation (6) with this value of e, Fig. 7 shows that the horizontal component of $L\,z$ is now 2.412, whose hyperbolic sine (see Fig. 8) is 5.53. The received current is consequently $\frac{3}{452 \times 5.53} = 0.0012$ ampere. The

* If in this first case the receiving telephone at B has a resistance of 75 ohms and an inductance of 0.1 henry, representing an impedance at $\omega = 1500$ of $167.7 \angle 63° 26'$ ohms, it will be found by inserting this value for $\mathcal{Z}$ in formula (3) that the received current at B is thereby reduced from $i = 0.0004905 \angle 148° 45'$ to $i = 0.0004236 \angle 123° 45'$. That is to say, the ignoring of the impedance of the telephone in this case produces an overestimation of the received current strength amounting to 25.8 per cent.

separation of the wires has here more than doubled the received current strength.

By watching the geometrical development of the computation, the utility of inductance in telephonic conductors is symbolically apparent in two ways. First, by making the length $(r + j\,l\,\omega)$ greater, it adds to the length of y, and thus augments the impedance at A and the effective voltage delivered to the line. Secondly, it increases the angle of z and $L\,z$, thus reducing the horizontal component a, upon which the value of sinh a so sensitively depends. On the

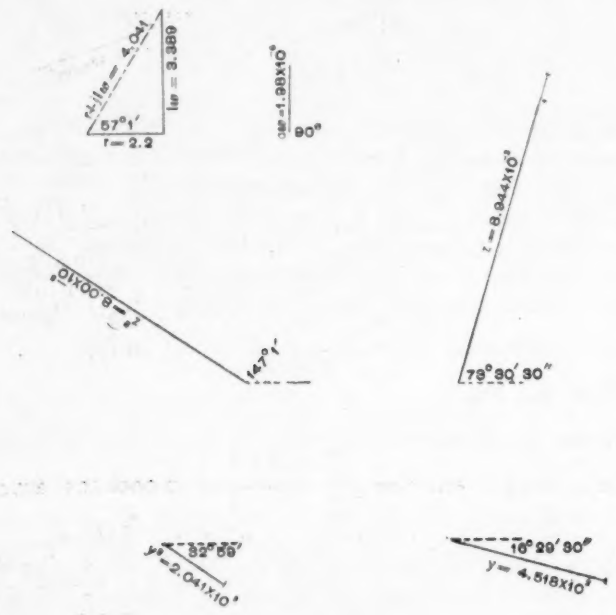


FIG. 6.

other hand, it will be evident that beyond a certain value the beneficial influence of inductance will cease.

Equations (1) and (4) indicate that when the circuit is sufficiently long to make the horizontal component of $L\,z$ more than z, the factor tanh $L\,z$ is practically unity, and the impedance of the circuit as apparent at the transmitter becomes practically constant, no matter how far the line be then extended. The effective voltage of delivery therefore remains constant, and the received current, as the length of line increases, depends entirely upon the reciprocal of sinh a. In other words, with a moderately long line of fixed and uniform electrical constants, the strength of the received current varies inversely as the hyperbolic sine of a fraction of its length, and not inversely as the square of its length. Fig. 8 gives the curve of hyperbolic sines, which may be employed when a table of these functions is not available. The dotted line represents a particular curve of squares. The agreement between the two curves is very fair until the variable exceeds 3.5, and, to a first approximation therefore, the law that assigns the amplitude of received current to the inverse square of the length is correct. This does not, of course, contravene Lord Kelvin's law of signal transmission, which asserts that the interval of time required to bring the amplitude of current strength received at the distant end of a cable (having small inductance in relation to its capacity) to a given fraction of the ultimate full maximum varies as the square of the cable's length. In the case of harmonic telephony before us we consider only the amplitude of harmonic current waves that have already practically reached their full development, and the progress of that development toward maturity, at the start, and in the initial stages of transmission, is removed from present consideration.

Third case: Two No. 10 A. W. G. copper wires, 0.1019 inch (0.2588 centimetre) in diameter, are suspended parallel and alone upon poles at an interaxial distance of one foot (30.48 centimetres). Assuming that their capacity, when insulated from each other and from ground, is 0.007 microfarad per mile, their separate inductances 2,138 millihenrys per mile, their resistance each 5.28 ohms, and their insulation to ground each 250,000 ohms per mile, required the distance at which harmonic telephony will be possible with the special transmitter above referred to, when the limiting current strength at $\omega = 1{,}500$ is 0.00025 ampere.

Here $r = 5.28$, $l = 2.138 \times 10^{-3}$, doubled $c = 1.4 \times 10^{-8}$, $g = 4 \times 10^{-6}$, $l\,\omega = 3.207$, $c\,\omega = 2.1 \times 10^{-5}$.

Constructing triangles as before, we find $(r + j\,l\,\omega) = 6.178\ \angle 31°\ 16'\ 30''$, and $(g + j\,c\,\omega) = 2.138 \times 10^{-5}\ \angle 79°\ 1'$, whence $z = 0.01149\ \angle 55°\ 8'\ 45''$, and $y = 537.6$ with neglected phase. The loop impedance at A is 1075 ohms, to which the transmitter will respond with a terminal E. M. F. of 6.7 volts by Fig. 1, or 3.35 volts to each wire. We have then the relation $(e/y \sinh a) = 0.00025$, or $\sinh a = 24.93$, so that (see Fig. 8) $a = 3.91$.

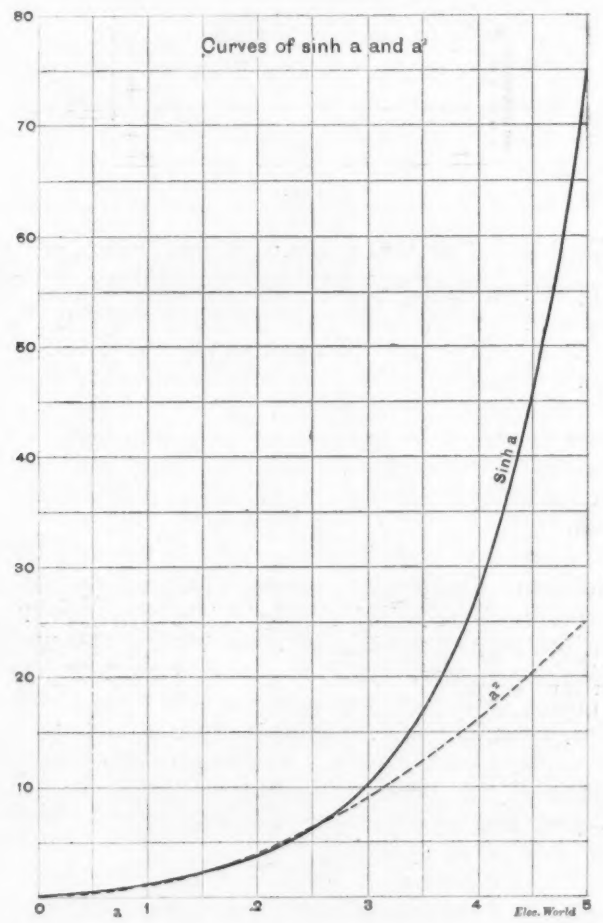


FIG. 8.

$L\,z$ is $3.91\ /\ (\cos\ 55°\ 8'\ 45'')$, or 6.842, and $L = 6.842\ /\ 0.01149 = 595$ miles. The harmonic sound reproduction would have the limiting amplitude at about 600 miles.

In conclusion, it may be pointed out that all the preceding formulae apply immediately to continuous current *leaky* circuits, by suppressing the influence of their inductance and capacity; that is, by equating l and c to zero. The consequent values of y and z are no longer complex quantities, and the equations degrade into ordinary scalar or algebraic formulae for determining the influence of uniform leakage upon the outgoing and received continuous currents.

Some Unique and Useful Methods of Measurement.—II.

BY GEO. T. HANCHETT.

IN the case of the dynamo, especially if it be a compound wound machine, there are a number of resistances which are troublesome to measure, and if there is but one machine the matter is made worse, since the electrical expert is deprived of all means of getting an independent current, and the useful and well-known fall of potential method becomes an impossibility. It is true that if we insert an ammeter in the shunt field while the machine is running and take the potential at the terminals of the shunt we may thus calculate its resistance. This is usually a good method, but sometimes when the ammeter is of large scale the current cannot be read accurately, and thus the calculated value of the resistance is doubtful. Similarly we can insert an ammeter in the main circuit and take the potential around the terminals of the series field, and thus determine its resistance, but here again the small difference of potential involved will be inaccurately measured by the voltmeter, which is very apt to have a scale reading of 150 volts and perhaps 500. Moreover, if the so-called series and long shunt connection is employed, the ammeter reading errs by the amount of current necessary for the shunt field.

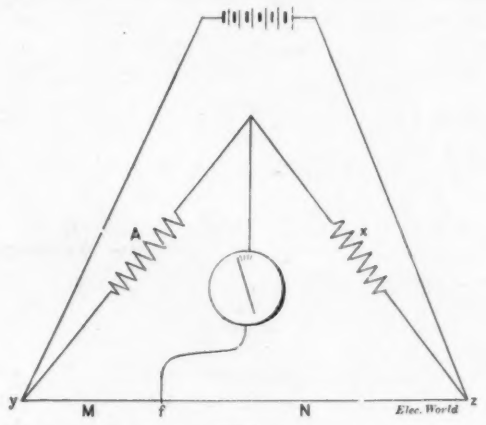


FIG. 7.

It is not always easy to cut in an ammeter between the brush and the series field, and at best a check measurement of these resistances would be desirable, if not necessary. For the purpose secure a resistance which can be measured by the fall of potential method, and at the same time give a good deflection on the scales, so as to insure an accurate measurement.

Having secured a resistance the value of which is either known or easily determined, the next thing to provide is a smooth, straight piece of wire, either iron or copper, about four feet long, and of as uniform cross-section as possible. Then connect this wire with the known and unknown resistances, as shown in Fig. 6. Upon a small block of wood, of suitable shape, wind a quantity of fine insulated copper wire. Over this coil place a pocket compass, or, if the latter is not at hand, suspend, by a fine silk fibre, a needle, magnetized on the fields of the dynamo. Connect as shown in Fig. 6 and with one or two cells of battery the equipment is complete.

Adjust the movable contact *f* along the wire and with a foot rule measure the lengths *M* and *N*. Then apply the time-honored formula:

$$M : A : : N : X; \text{ whence } X = \frac{A\ N}{M}.$$

Here *y z* represents the wire, *A* the known and *X* the unknown resistance.

If a battery is not available, one can be made by using a pail of salt water and two lead plates. Charging while the machine is running, it will be found that an E. M. F. of two volts is at hand upon shutting down. It will not last long, it is true, but if the test is made at once there will be no difficulty.

The resistance chosen should be governed by the resistance desired to be measured. If this is low, the resistance chosen should be low, and vice versa. The known resistance is somewhat governed by the scales of the voltmeter and ammeter, as it is necessary to have a good deflection on each when measuring it by the fall of potential method. On no account should it be subjected to such a current as would heat it and thus change its value, as it is cold when used to measure the desired resistance. It will be very curious if a suitable resistance is not available. The writer would suggest the following:

Low resistances to use in measuring armature resistance or the resistance of series coils: (1) The known resistance of the ammeter. (2) A spool of wire from the engineer's supply. This resistance can be verified by computing from length, gauge number and table of ohms per foot. (3) The rheostats of the switchboards in parallel. They can be measured singly and their resistance in parallel computed if it is more accurate to do so. (4) One of the building circuits short circuited at its further end, all lamps cut out. (5) Several resistances, such as are used in connection with incandescent arc lamps, in parallel. (See Fig. 3.)

High resistances used in measuring shunt coils: (1) The known resistance of the voltmeter. (2) The rheostats of the switchboard connected in series. (3) Incandescent arc lamp resistances in series. A little ingenuity will suggest many more.

The galvanometer is likely to be the most difficult problem. A small detector is invaluable in this case. An operator is inclined to lose patience with a needle suspended by a fibre, but yet, with care, it will yield better results than a detector, being more delicately poised.

The writer, with a bit of looking glass, a quantity of annunciator wire, a short piece of stout wire for a support for the fibre, a little mucilage, a few bits of watch spring and a silk thread from his necktie, has constructed, on the spot, in half an hour's time, a galvanometer such as is shown in Fig.

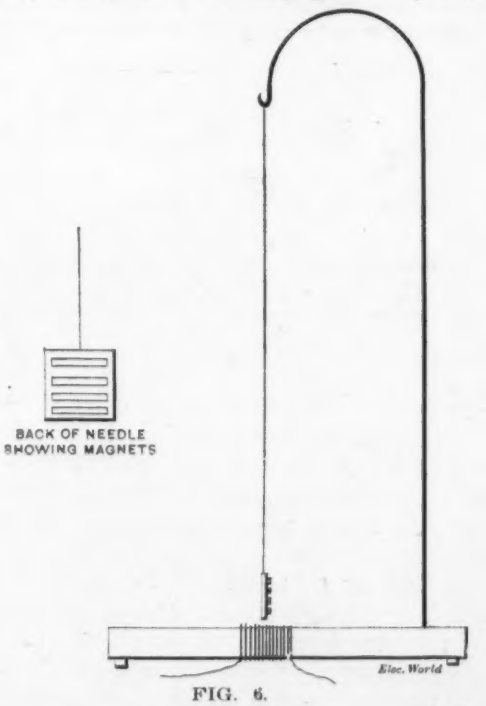


FIG. 6.

7. The data obtained by it amply pay for the trouble of construction. The cost is nothing.

The insulation resistance of the dynamo is a desirable thing

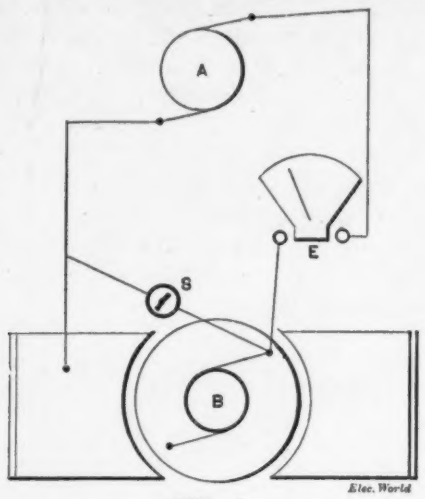


FIG. 8.

to know, and although the method to be given here is not a new one, it is not as generally known as it should be. Connect as shown in Fig. 8. Let E be a voltmeter and S a snap switch. Throw off all circuits and by means of the shunt rheostat crowd the voltage of the machine A up to a maximum. B must be at rest. Then with the snap switch open take a voltmeter reading. Call this V'. Immediately close the snap switch and take a new reading, V. Then the insulation resistance of the machine will be

$$R = \frac{(V - V')\,R'}{V'},$$

where R' is the voltmeter resistance and R the insulation resistance. The proof of this is as follows:

With the snap switch open we have the insulation resistance and the voltmeter in series. Let C be the current flowing.

$$C = \frac{V'}{R'} = \frac{V}{R + R'}; \text{ whence } R = \frac{(V - V')\,R'}{V'}.$$

This, of course, requires another dynamo with which to test. The insulation resistance can be found by using the

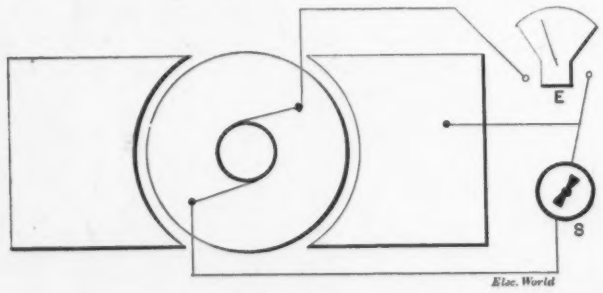


FIG. 9.

electromotive force of the machine itself in the following manner: Connect, as shown in Fig. 9, and in precisely the same way as before measure and compute. Then connect with voltmeter and snap switch interchanged and repeat. If the results check fairly well, they represent the insulation resistance of the machine.

This method has an element of danger from the fact that on throwing the snap switch a good ground is established between the wires and the frame. Another ground at a great potential difference from this one will work mischief, and unfortunately the voltmeter, while it will give warning on the side near the snap switch by a large deflection, will give less and less warning in this way as the ground is nearer the other side, and therefore dangerous.

This danger may be avoided by taking preliminary deflections on either side of the machine.

On the Design of Electromagnets for Specific Duty.—II.

BY E. R. CARICHOFF.

ELECTROMAGNETS may be designed, as was shown in a previous article, with a certain length of air gap which if multiplied by the pull between the armature and the poles separated by this air gap gives a maximum. The length of this air gap is different for different values of the magnetic induction, and may readily be determined.

For example: Suppose the magnet to be made of cast steel, the $\mathfrak{B}$ $\mathfrak{H}$ curve of which is furnished by the Syracuse Steel Foundry Co., and plotted in Fig. 1 as curve 1.

Draw a tangent to any point of curve 1 and parallel to it draw a line through the origin, then the point where this parallel cuts the horizontal line drawn through the point of tangency is one point of curve 2, the abscissae of which represent the magneto-motive forces for different values of the induction in the variable air gap above defined divided by the length of the magnetic circuit in the steel.

The abscissae of curve 3 represent the length of these variable air gaps in ten-thousandths of a centimetre, corresponding to different values of the induction $\mathfrak{B}$; also for each centimetre length of the magnetic circuit in the steel. The successive points of this curve are determined from those of curve 2 by dividing each abscissa by its corresponding ordinate.

Curve 4 is plotted from a table that is given in S. P. Thompson's book on magnets and was calculated from Maxwell's formula,

$$P = \frac{\mathfrak{B}^2 A}{8\pi},$$

using such units that the abscissae are pounds per square inch of polar area instead of dynes per square centimetre.

Denote the abscissae of curve 4 by P in pounds, those of curve 3 by L in .0001 centimetres, the length of the magnetic circuit in the steel by l in centimetres, and the polar area by A in square inches.

Then work, being defined in this case as initial pull times travel, is expressed by

$$W = P \times L \times l \times A.$$

Assume W to be ten centimetre pounds, then

$$A\,l = \frac{10}{P\,L},$$

and the values of $\frac{10}{P\,L}$, corresponding to the successive ordinates $\mathfrak{B}$, give the abscissae of curve 5. $A\,l$ is a volume n which l is in centimetres and A in square inches, and

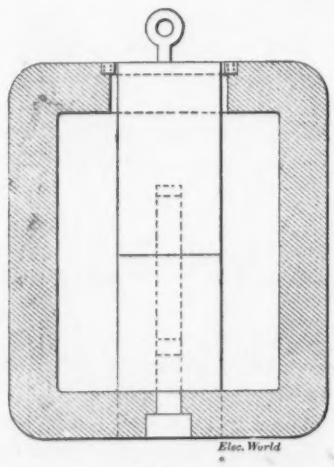


FIG. 2.

this is seen to be proportional to the work, as above defined, which the magnet is capable of doing.

To illustrate the use of curve 5, suppose it is required to move a lever arm a distance of one centimetre against a pull of 100 pounds, $W = 100$ centimetre pounds.

Assume $\mathfrak{B} = 13,500$. We see that for this value of $\mathfrak{B}$ and for $W = 10$ centimetre pounds $A\,l = 18.5$; for $W = 100$ centimetre pounds $A\,l = 185$. Of course we may give to l or A any value we please, but as the magneto-motive orce $\mathfrak{F}$ varies directly with l, there is economy in making A large and l small—just long enough, in fact, to permit the necessary winding.

As an example, try l at 20 centimetre and A at 9 1-4 square inches. The total magneto-motive force becomes

$$\mathfrak{F} = 20\,(18.3 + 70) = 1,766,$$

and the ampere turns are about eight-tenths of this or 1,420. If these dimensions do not afford sufficient space for proper winding it will be necessary to increase l.

neck of the magnet may be made very short and of large area. The upper cylinder is guided by the brass ring at the neck and by the brass rod sliding in the lower cylinder.

$\mathfrak{B}$.	P.	L.	$P \times L$.	$\frac{10}{P \times L}$	$\mathfrak{F}$ for 1 cm. of steel plus $\mathfrak{F}$ for air gap defined.	Values of l for $\mathfrak{F}$ = 1,000.
8,000	37.	.00097	.0358	279.	12.8	78.2
8,500	41.5	.00112	.0465	215.	14.8	67.7
9,000	46.7	.0013	.0607	164.	17.4	57.6
9,500	51.9	.00152	.079	127.	21.	47.7
10,000	57.7	.00176	.1015	98.5	25.	40.
10,500	63.5	.00205	.13	76.5	30.0	33.3
11,000	69.8	.0024	.1675	60.	35.7	28.0
11,500	76.2	.00278	.212	47.	42.5	23.5
12,000	83.1	.00324	.269	37.3	50.4	19.8
12,500	90.	.00374	.337	29.8	60.4	16.6
13,000	97.5	.00437	.426	23.6	72.2	13.9
13,500	105.	.00518	.545	18.3	88.4	11.3
14,000	113.1	.00625	.707	14.1	108.7	9.2
14,500	121.4	.00778	.946	10.6	137.	7.3
15,000	129.7	.01015	1.315	7.73	184.	5.45
15,500	138.8	.0146	2.02	4.93	260.	3.78

The accompanying table has been arranged partly from

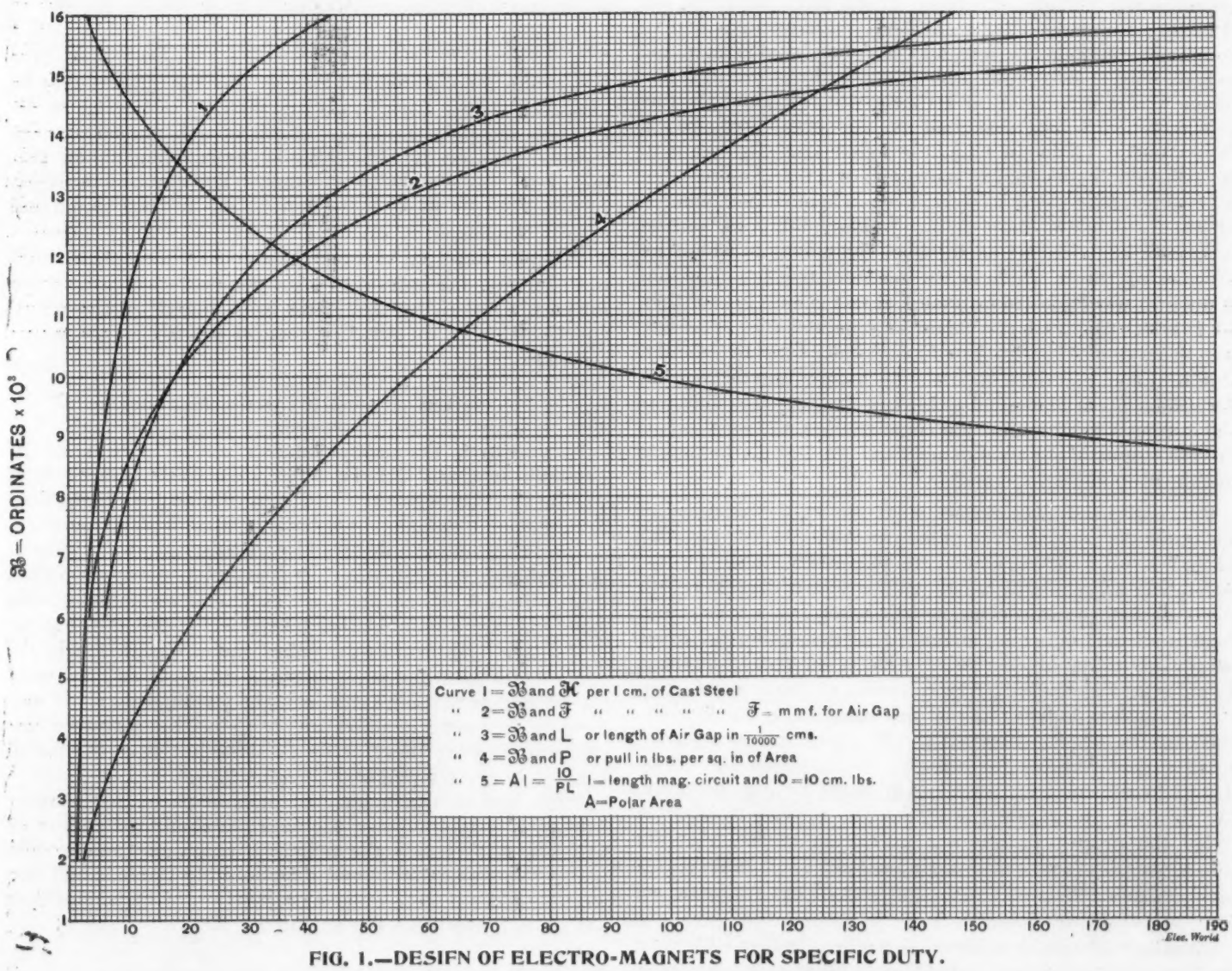

B = ORDINATES x 10³
Curve 1 = B and H per 1 cm. of Cast Steel
" 2 = B and F " " " " " " F = m m f. for Air Gap
" 3 = B and L or length of Air Gap in 1/10000 cms.
" 4 = B and P or pull in lbs. per sq. in of Area
" 5 = A l = 10/PL l = length mag. circuit and 10 = 10 cm. lbs.
A = Polar Area
Elec. World

FIG. 1.—DESIFN OF ELECTRO-MAGNETS FOR SPECIFIC DUTY.

The total length of the air gap will be

$$L\,l \text{ or } .00515 \times 20 = .103 \text{ centimetre.}$$

If the air gap is divided into two variable parts, it is evident that the movement of the armature can be only one-half of the total air gap, and a twenty to one lever will be required to move the 100 pounds over a distance of one centimetre, as required. But if one air gap only is variable, the other being an almost negligible constant, a ten to one lever will suffice.

A form of magnet sketched in Fig. 2 will afford one constant and one variable air gap. The constant air gap at the

the curves above and partly from calculations on the slide rule. It shows some very interesting relations.

If it is desired to move the lever arm against the increasing force of a spring, the magnet may be made to balance this force at two points of its travel by selecting the induction to give the required pull at these two points.

Much of this article and of the one preceding has been presented in the form of suggestions, which may be elaborated to suit individual cases.

The main facts that seemed to the writer as useful are that there is a certain length of air gap for any given magnet of

uniform cross-section where the pull between armature and poles is lessened if the polar area is either increased or diminished, and that the pull under these conditions, multiplied by the length of this air gap, is greater than the pull with any other air gap multiplied by the length of the latter.

The use of different systems of units may seem objectionable to some, but when accustomed to the calculation of magnets in pounds per square inch the term grows to mean something more definite to the average worker than dynes per square centimetre. It is a simple matter to change the relation, and those who prefer the use of the same dimensions throughout may pass a pleasant hour in drawing curves to suit the units they prefer.

On the Design of Electromagnets for Specific Duty.

BY P. MATTHEWS.

The editor of The Electrical World, in the last issue of this journal, may be pardoned, I think, for getting too enthusiastic in the editorial over a professed simple method of geometrically solving problems which have bothered the heads of many eminent men and every one who has had to design electromagnets for specific duty. Although the method may at first sight look plausible from the figure, a glance at the mathematical symbols will no doubt by this time have convinced him that he has only discovered a mare's nest. To begin with, the writer does not seem to have thought it necessary to state definitely the conditions of the problem he is trying to solve. What is fixed and what is variable? In his method for determining the polar section he speaks of "the part of the iron characteristic where we are working," from which one would infer that the induction in the iron was regarded as fixed, but this cannot be, for then the greatest tractive force would be obtained with the polar section $= o$, and the tractive force would then be infinity. One is therefore driven to make an assumption as to what the conditions are intended to be, and the only plausible one that suggests itself is that the ampere turns, the iron circuit and the length of the air gap are fixed, leaving the induction and the air gap section variable.

But, under these conditions, what can be the meaning of the statement on page 113, The Electrical World, Jan. 27? From this we draw the conclusion that when the air gap reluctance is expressed by a line parallel to the tangent drawn at the part of the iron characteristic where we are working, there is no gain either by increasing or decreasing the polar area. Increasing or decreasing what polar area? There is no polar area specified. The direction of the line $o\,F$, Fig. 1, is altogether independent of this area, being the line expressing the relation between the flux per unit area, or induction, and the magnetomotive force. This line does change its direction with the length of the air gap, however. Let us then investigate the method as applied to what is styled the proper air gap for maximum power, viz., the pull $\times$ length of gap. Although I cannot agree that this expression gives the work to be got out of the magnetic attraction, yet we will proceed.

To take a simple case, suppose we are dealing with very small magnetizing forces in the iron, so that its reluctance is constant. Let reluctance of iron $= r$; and of air gap $= \frac{l}{A}$, where $l =$ length of air gap, $A =$ area of air gap, total number of lines of force $= N$, air gap induction $= \mathfrak{B}$, magnetomotive force $= \mathfrak{F}$, mechanical force $= f$.

Then

$$f = \frac{N^2}{8\,\pi\,A},$$

$$N = \frac{A\,\mathfrak{F}}{A\,r + l},$$

$$l\,f = \frac{A\,\mathfrak{F}^2\,l}{\pi\,(r\,A + l)^2}.$$

Differentiating with regard to l and equating to o,

$$-\frac{2}{r\,A + l} + \frac{1}{l} = o,$$

$$\frac{l}{A} = r,$$

or, in other words, by decreasing or increasing only the length makes the air gap reluctance equal to that of the iron.

Now, by following out the geometrical method under discussion, the line $o\,F$, Fig. 1, we see, becomes coincident with the tangent, which means: the polar section and iron section being determined, make the length of the air gap such that

$$\frac{\text{reluctance of air gap}}{\text{reluctance of iron}} = \frac{\text{area of iron section}}{\text{area of polar section}}.$$

(If Mr. Matthews will refer again to the article which he criticises, he will find that he has misunderstood the problem considered, which is as follows: With a given magnet having a definite number of ampere turns, the product of the pull and length of air gap is a maximum when $\frac{d\,\mathfrak{F}}{d\,\mathfrak{B}}$ is the same for the iron and air gap, and this equality may be produced in two ways, as shown—first by increasing or decreasing the polar area, the length of gap remaining constant; or, second, by shortening or lengthening the air gap, the polar area remaining constant. The author apparently considered that those interested in the subject would not require explanations on obvious and elementary points—such as, for example, that the polar area may be varied without changing the cross-section of the core—which accounts for part of a criticism that seems to be entirely due to a misapprehension of the strictly practical bearing of the article criticised.)

The Use of Steel in Electric Machines.

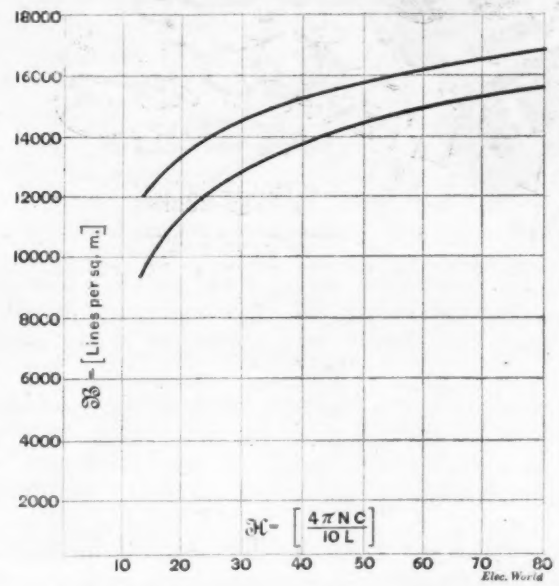
In a paper in the current number of the "Journal of the Franklin Institute" Mr. H. F. Parshall treats of the use of steel in the magnetic parts of electrical machines, and shows the great improvements that have resulted from its substitution in street railway motors in particular, due to its greater permeability over cast iron. It is stated that magnet frames made of steel are 25 per cent. cheaper than those of cast iron, and that a combination frame using steel in the polar projections, cast iron in the yokes and wrought iron in the cores costs about the same as one of cast steel, and possesses the advantage that both cast iron and forgings are more uniform in magnetic qualities, easier to machine, require less chipping and are more easily finished, but have the disadvantage of greater weight.

Referring to the quality of steel required for magnet frames, it is asserted that the effect of combined carbon or graphite is to lessen the magnetic continuity and greatly lessen the permeability, and that, roughly stated, good cast steel should not have greater percentages of impurities than are given in the following analysis:

Carbon	.25
Manganese	.60
Silicon	.20
Phosphorus	.08
Sulphur	.05

In practice, carbon is the most objectionable impurity, and can with advantage be restricted to smaller amounts than above quoted. The permeability seems to be proportional to the amount of carbon contained. Manganese below .6 per cent. has apparently little effect, but if present in large quantities deprives the steel of nearly all magnetic suscepti-

bilities, a 12 per cent. mixture having scarcely greater magnetic susceptibility than air. Silicon, at the magnetic densities used in practice, is less objectionable than carbon, but



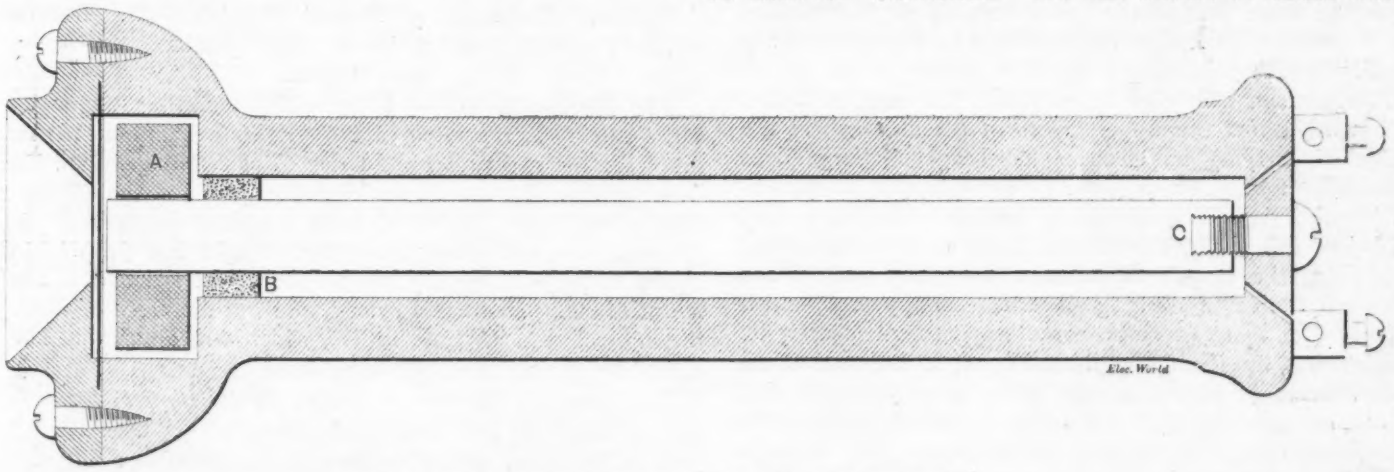
PERMEABILITY CURVES FOR STEEL.

at high densities appears to diminish the magnetic qualities of iron to some extent, and is objectionable through facilitating the formation of blow holes and from its hardening effect. Phosphorus and sulphur, limited to the amounts stated above, are not objectionable. In the figure the upper curve shows what in ordinary practice is termed good steel and the lower curve what is termed poor steel.

The effect of annealing on the permeability of cast steel varies considerably, according to the foundry treatment, but seems to increase the permeability for low magnetizations, with a less marked effect for high magnetizations. Tempering reduces the permeability.

There is little difference between the analysis of the steel plates used for armature cores and that of wrought iron; in general, plates made by the steel process show more manganese, and those made by the iron process more silicon. From tests made up to the present time, the conclusions seem warranted that phosphorus is especially objectionable as regards hysteretic loss.

With respect to the use of steel in general for magnetic purposes, it may be stated that the most valuable products are those that are found to be softest and most homogeneous. In a given sample any physical change which increases the permeability correspondingly decreases the hysteresis. In different samples steel of the highest permeability may not give the best results as to hysteresis; thus, a trace of uncombined carbon has a tendency to greatly lessen the permeability, but does not seem to greatly affect the hysteresis. The most hoped-for improvements in steel are in the making of castings free from blow holes and surface defects, requiring a minimum of finish, and which are soft and easily machined. Such castings would certainly prove satisfactory from a magnetic standpoint.



FULL SIZE SECTIONAL VIEW OF TELEPHONE.

How to Make a Telephone.—II.

As the cut shows the telephone full size all of the necessary dimensions may be obtained from it. The magnet is of 3-8 inch Stubb's or other magnet steel, which can be obtained from any dealer in electrical supplies. The hole for a No. 8 machine screw, *C*, should be drilled and tapped before tempering. After tempering the rod may be magnetized by holding across the gap of a dynamo, or by simply letting it remain for a short time in contact with one of the pole pieces. Better results would be obtained if a half inch of the coil end of the magnet were cut off, a small hole tapped and a piece of 1-4 inch iron screwed in, and the coil placed around this.

The coil *A* may be wound on a paper spool, and should contain one-half ounce of No. 36 silk covered magnet wire. Heavier wires—say No, 22—should lead from the binding posts to the coil, and the two wires of the coil be soldered to these in the space underneath the diaphragm. Paper, as shown at *B*, should be wound about the magnet so that it may be held firmly in place; then by means of the screw, *B*, the necessary adjustment in relation to the diaphragm may be made and maintained. The case should be turned from mahogany or other hard wood. The diaphragm is simply a piece of photographer's tin-type. The space above the diaphragm need not be as deep as shown, but merely sandpapered enough to clear.

Tinning Cast Iron.

A company in France tins cast iron by first covering it electrically with a coating of nickel and iron or cobalt and iron. One kilogram of sulphate, nitrate or chlorate of nickel is mixed with 3 kilograms of the sulphate of iron and 1 kilogram of citric or tartaric acid; or 1-2 kilogram of sulphate, nitric or chlorate of cobalt with 3 kilograms of sulphate of iron; this is dissolved in 100 litres of water, to which a sufficient quantity of a caustic alkali is added to neutralize the solution completely; a little bisulphate of potash, soda or ammonia may be added to increase the conductivity. The cast iron is immersed and a current is passed having a density of about 50 amperes per square metre of surface to be coated; about seven volts are required.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS. BY CARL HERING.

ELECTRO-PHYSICS.

Mechanical Equivalent of Heat.—In the Digest, April 1, the result of the recent redetermination of Mr. Griffiths was given as 778.99, as stated by him in a recent Royal Society communication. According to the Lond. "Elec.," Jan. 26, he now announces that the corrected value in terms of a hermal unit at 15° C. is given as 4.1982×10^7 ergs, with an estimated limit of error equal to $\pm$ 0.0020; assuming that $g = 981.17$, the mechanical equivalent is equal to 779.77. (It will be seen that this corrected value is exactly 0.1 per cent. greater than the first one given; the figures given in the Digest April 1, deduced from the former value, should therefore be corrected by this amount.

Cosmical Electricity.—The Lond. "Elec. Rev.," Jan. 26, discusses some statements made in Prof. Thomson's recent lecture on the subject (see The Electrical World, Jan. 6, 1894, page 4); the criticism is, on the whole, unfavorable, the statements being referred to as "crude theorizing"; if the earth's magnetism were due to the movement of its electrostatic field, the most violent disturbances could be expected during thunderstorms, amounting even to reversals of the terrestrial magnetism, which we know is not the case; it doubts the statement that the upper layers of the atmosphere are capable of carrying an electric "discharge" (charge?), as Heydweiller found it impossible to communicate electrification to air; regarding the idea that thunderstorms may possibly be due to flaws in the dense air, it stated that if this is the case, the earth's electrostatic field, and with it the earth's magnetism, must long since have disappeared, and it suggests that there must be some way of replenishing its outer coating, but it can imagine none; regarding the auroral display, belief is expressed that it is more probable that this consists of discharges in the upper rarefied layers of the atmosphere, due to changes in the magnetic field through which the earth is passing.

Discharges at Low Temperature.—According to the Lond. "Elec. Rev.," Jan. 26, Prof. Dewar, in his recent lecture, showed that by cooling a portion of a vacuum tube with liquid oxygen the resistance became so high that phosphorescence ceased entirely, and the discharge found another path, showing, as he states, that something had been frozen out, which had before enabled electricity to pass. By enormously increasing the voltage the current may be made to pass even through the frozen out mercury vacuum, but the discharge assumes a totally different form, the diffused phosphorescence giving place to luminous streaks.

Thermo-Couple of Electrolytes and Unpolarizing Electrodes.—The "Elek. Zeit.," Jan. 18, abstracts from "Wied. Ann.," volume L., page 696, an article by Mr. Gockel, in which he describes researches with a couple, each half consisting of mercury and solid mercury salts, connected together by a soluble salt, one side being warm and the other cold; he finds that, in general, the thermo-electric force increases with the dilution of the soluble salt; numerous soluble salts were experimented with.

Influence Machines.—The Lond. "Elec. Rev.," Jan. 19, reprints an illustrated description by Mr. Pidgeon and another by Mr. Wimshurst on improved forms of their machines, as described before the Physical Society in June; the description has already been abstracted in the Digest July 22.

Theory of Electric and Magnetic Phenomena.—"La Lum. Elec.," Jan. 20, abstracts a paper by Mr. Vaschy, in which he develops a theory not based on any hypotheses, but based simply on mathematical deductions from experimental results.

Dynamical Theory of the Electric and Luminiferous Medium.—Mr. Larmor's Royal Society paper is concluded in the Lond. "Elec. Rev.," Jan. 19.

Propagation of Electric Waves Through Electrolytes.—The "Elek. Zeit.," Jan. 18, abstracts briefly an article by Mr. Yule from "Wied. Ann.," volume L., page 742.

Correlation of Solar and Magnetic Phenomena.—The Lond. "Elec.," Jan. 26, reprints from "Nature" letters from Dr. Veeder and Mr. Ellis.

Dielectric Constants of Biaxial Crystals.—Mr. Borel's article is continued in "La Lum. Elec.," Jan. 20.

MAGNETISM.

The Electromagnet.—A long and interesting paper by Dr. Froelich is reprinted in the "Elek. Zeit.," Jan. 18; he discusses the two present theories of electromagnetism, the development of a law of the electromagnet and the application of this law. He develops a simple mathematical expression, deduced partly from the straight line proportion shown some years ago by Mr. Kennelly; the article does not admit of being abstracted briefly, and will therefore be made the subject of a separate article, which will appear in The Electrical World in some future issue.

Increasing the Number of Phases for Rotating Fields.—In a short article by Dr. Behn-Eschenburg in the "Elek. Zeit.," Jan. 18, he states that when two equal currents of different phases generate the same ampere turns around the same magnet, the resulting magnetization will have a phase midway between the two phases, and the result is therefore the same as if a third and single current of a phase midway between the two, but of a different number of turns, had been used; if the original phases differ by 90°, and if their combined M. M. F., each having t turns, shall be the same as that of each current with T turns, then t must be equal to $T \div \sqrt{2}$. He then shows that the same method permits one to obtain a symmetrical distribution of the field with an unsymmetrical division of the phases, as, for instance, with two-phase currents differing by 60°; phase 1 and 2 will differ by 60°, phase 3 and 4 are produced by the reversed effects of 1 and 2; between 2 and 3 and between 4 and 1 there will then be a phase difference of 120°; but if 2 and 3 are combined, as above described, a phase will be obtained midway between them; the same is true of 4 and 1, thus giving six regular phases of 60°; if, in general, there are m phases, then if T and t signify the same as above, then $\sqrt{2}$ in the abov formula must be replaced by $\cos(\pi \div m)$.

Magnetization of Solid and Hollow Iron Cylinders.—The "Elek. Zeit.," Jan. 18, abstracts a paper from "Wied. Ann.," volume L., page 705, by Mr. Grotrian; the results in-

dicate that with weak magnetizing forces, the outer layers of the iron are magnetized first; for the construction of dynamos he draws the conclusion that for light machines hollow magnets are to be recommended. (The hollow cores seem to have been bored out after having been tested in solid form; the abstract contains no data to show whether a smaller solid core of an equal cross-section to that of the hollow core is better or worse; such a solid core would evidently require less watts and be higher than the hollow one.) He also calls attention to the fact that the magnetic reluctance at low saturation cannot be considered to be even approximately inversely proportional to the cross-section of the iron, in the case of hollow cylinders.

Pull of Magnets.—The series of editorials in "Ind. and Iron" is continued in the issue of Jan. 19, in which the subject of the relation of the self-induction to the pull of magnets is discussed; it is interesting reading, but does not admit of being abstracted; he states among other things that if the magnet is to exert a certain pull at a certain distance, the pull varies as the self-induction, from which it will be seen that, contrary to the claims of some inventors, it is impossible to make an electromagnet to have a good pull with small self-induction; the pull of any magnet is equal to half the square of the current multiplied by the rate of increase of the self-induction when the armature moves.

Magnetism at Low Temperature.—According to the Lond. "Elec. Rev." and "Elec. Eng.," Jan. 26, Prof. Dewar, in his recent lecture, verified the idea of Faraday and showed that a magnet at — 200° C. had its power increased 50 per cent. This was shown by direct experiment by coiling a wire around a magnet and immersing the end of the magnet in liquid air, when an electric current was instantly generated in the wire.

Magnetic Measurements.—Under the title "More Magnetic Mysteries" Mr. Evershed, in the Lond. "Elec.," Jan. 26, quotes at considerable length a paper by Mr. Gray (of Rose Polytechnic Institute, written early in 1892) describing a modified method of measuring magnetic quantities in large masses of iron, in which he records, not the total value of the induction for each of several particular values of the magnetizing force, but the curve showing the rise of current with time immediately after the circuit is closed; the apparatus and the resulting curves are given; Mr. Evershed comments briefly on the method, pointing out errors.

Electro-Chemical Effects on Magnetizing Iron.—See under Electro-chemistry.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Injurious Effects of Electric Railways on Physical Measurements.—Messrs. Meyer & Muetzel, in a long article in the "Elek. Zeit.," Jan. 18, describe in detail measurements and calculations to determine the effect which an electric railway has on the measuring instruments in the Breslau University, around which an electric railway passes. It is shown that calculations and observations agree as far as the passing car is concerned, and that therefore calculations may be made in advance and depended upon; for an allowable error of 0.1 minute of arc, for instance, they calculate that a distance of about 500 feet is sufficient; but a great source of disturbance lies in the earth return current, which they measure and calculate, showing that this earth current has a very appreciable effect, but they found that this current also exists, though in a less degree, at night, when the railway currents have ceased. Their conclusions are that fine physical measurements of magnetic or electric quantities can be made only at night in this building.

Measuring the Light from Stars.—According to "Nature," Jan. 18, Prof. Minchin has employed his seleno-aluminium-aenanthol cells, 3 square millimetres in area, in connection with a large telescope, and obtained 40 divisions for Venus at 1-4 disc, 9 for Sirius and none for Aldebaran; 460 divisions correspond to one volt.

Measuring Instruments.—In the serial of Messrs. Niblet and Ewing, in the Lond. "Elec. Eng.," Jan. 19, Jenkins' resistance measurer is described and illustrated.

Registering Instruments.—The Raps apparatus, described in the Digest Jan. 27, is described in detail in "La Lum. Elec.," Jan. 20.

DYNAMOS AND MOTORS.

Experiments with Brown Non-Synchronous Motors.—The Lond. "Elec. Rev.," Jan. 19, continues its article on this subject, the first part of which was abstracted in the Digest Jan. 13; the article appears to be the same as the one abstracted and illustrated in the Digest Jan. 20.

Irregularities in the Action of Dynamos.—The translation of this article from the French is continued in the Lond. "Elec. Eng.," Jan. 19 and 26, under the heading of "Faults in Dynamos." A translation of the article is also being published in the Lond. "Elec. Rev.," beginning with the issue of Jan. 26.

Mechanical Applications of Electricity.—In the profusely illustrated serial by Mr. Richard in "La Lum. Elec.," Jan. 20, illustrations and descriptions are given of cranes, hoisting apparatus, percussion drills and other apparatus.

ARC AND INCANDESCENT LIGHTS.

Arc Lamps.—"La Lum. Elec.," Jan. 20, publishes a table of measurements of various European arc lamps made in 1885, giving the current, voltage, spherical intensity and watts per candle, the mean of the latter being about 0.55 watts per mean spherical candle.

TRANSMISSION OF POWER.

Transmission of Power Plant in Russia.—The Lond. "Elec. Eng.," Jan. 26, reports that a German syndicate has secured a concession from the Russian government for the erection of a gigantic electric power installation for transmitting the energy from the Imatra Falls in Finland to St. Petersburg; no further information is given.

Transmission of Power in Sweden.—According to "Engineering," a plant has recently been opened at Gringesberg, in which 400 h. p. are transmitted seven to eight miles to some mines; the current is transformed from 400 volts up to 5,000; it is used in motors, but what kind of motors is not stated.

Niagara Falls Plant.—The Lond. "Elec.," Jan. 26, contains an editorial on the Niagara Falls plant, giving, however, nothing new.

ELECTRIC RAILWAYS.

High-Speed Railways.—In the Lond. "Elec. Eng.," Jan. 12, Mr. Wolff criticises Mr. Lea's statement (see Digest, Jan. 27), and claims that there is no real disparity between the air resistance values of Hopkinson and Crosby, and that the difference is due to the skin friction, which, although small per square foot, forms a large part of the resistance of trains and varies with the square of the velocity. In Mr. Lea's reply, in the issue of Jan. 19, he does not agree that the skin friction forms a large part of the resistance, nor that it varies with the square of the velocity; the latest experiments show that even the head resistance varies with the first and not with the second power of the velocity; the skin friction in the case discussed is extremely small; if the air resistance is assumed to be equal over the whole area of the train, 8,000 square feet, then its value hardly exceeds 3-8 pound per square foot, while if 15 pounds per square foot is taken for the head resistance, then the skin friction is only 1-5 pound per square foot, which, he says, may be taken as fair average values; in the usual railroad, side winds cause a much greater loss than those dead ahead, but this, he says, is not due solely to the air resistance, as the weight is thrown more

on one track, which increases the track resistance enormously; he doubts whether in a properly designed train the skin friction at high speeds requires the expenditure of any serious amount of energy, certainly not to the same extent as the head resistance, but the absolute lack of reliable data makes it impossible to be certain.

Heilmann Locomotive.—According to the Lond. "Elec.," Jan. 26, this locomotive was tried between Havre and Paris, drawing 13 cars at a speed of 75 miles an hour; no further information is given.

Accumulator Traction.—The Lond. "Elec. Eng.," Jan. 19, quotes from a communication by Mr. Epstein to the London "Standard," in which he answers the objections to accumulators, based on their great weight and cost of renewal; regarding the first, he said that the additional weight of an accumulator car over an ordinary electric car is only about 20 per cent., and as regards the cost of renewals, practical working has established the fact that a maintenance rate of 3 cents per car mile leaves a very fair margin of profit; it can be shown that the cost of working is not more than in the trolley system.

Regulations.—The Lond. "Elec.," Jan. 26, publishes a discussion at the council and committee meeting of the Tramways Institute of the Board of Trade rules, mentioned in the Digest Dec. 16.

Liverpool Overhead Railway.—According to the Lond. "Elec. Rev.," Jan. 19, the excellent manner in which this road has been equipped is shown by the fact that during the ten months in which it has been in operation 96 per cent. of the trains, which are run at 5-minute intervals, were on time.

City and South London Railway.—According to the Lond. "Elec.," Jan. 26, the loco and generating expenses during the last half year were 12.4 cents per car mile.

Douglas-Laxey Railway.—The Lond. "Elec.," Jan. 19, gives a short illustrated description of this railway.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Hours of Lighting.—The Lond. "Elec.," Jan. 19, publishes several curves, showing the average hour at which lights are turned on in London, covering a period of one whole year; a similar curve is given for the hours at which they are turned off in the morning; another curve is given for the time at which the sun sets and the hours of turning on the lights for two large London stations for two years, showing a uniformity; the average time at which lighting is begun seems to be but a few minutes before sunset; in estimating the total duration of artificial lighting throughout the year, it states that the time between sunrise and sunset may be taken as the average time of lighting; in determining the times of lighting up, it is assumed that the middle point of the steepest part of the load curve represents the average time for that particular day (as the curves will be different for different latitudes they are not reproduced here); the latest hours are about July 1 and the earliest on December 15; in the morning curve the earliest is Jan. 15 and the latest Dec. 31; another curve is given, deduced from the sunset curve, showing the total hours of lighting in a year from dusk to any given time, the ordinates representing the total hours of lighting and the abscissas the time of day.

Refuse Destructors for Electric Lighting.—"Ind. and Iron," Jan. 19 and 26, reprints a report of the Shoreditch electric lighting committee, in which they discuss a number of points and conclude that the use of the destructor by itself will effect a large saving (of at least $7,500) on the present expenses, even without any complete utilization of its heat; opinion is expressed that to use the power for electric lighting is the most remunerative way, and that with the combined scheme a further saving of more than $10,000 per year may be anticipated.

Gas Engines in Electric Lighting Stations.—Mr. Borquin's article is continued in "La Lum. Elec.," Jan. 20; arc lamps, power, gas and the incandescent gas burners are discussed; numerous figures are given for making comparisons; at the rate of 5 litres per candle hour a cubic metre of gas will give 200 candle hours in a Wenham gas burner, while by means of a gas engine he shows that it can give 654 watt hours at the lamp, which, at the rate of one watt per candle of mean spherical illumination of an arc lamp, corresponds to 654 candle hours.

Siemens-Willans Combined Dynamo and Engine.—The Lond. "Elec. Eng.," Jan. 26, publishes an efficiency curve and a table of data, giving the results of a recent test made by Prof. Kennedy, showing excellent results; at full load the combined efficiency was 88 per cent., and the number of pounds of water per electrical h. p. was 23.8; for one-quarter load these figures were 63 and 27.9 respectively.

Willans Engines.—Messrs. Willans & Robinson publish a statement that they have received orders for about one-half of the entire horse power for public lighting stations in the United Kingdom.

Motive Power and Gearing.—In his serial in the Lond. "Elec.," Jan. 19, Mr. Carter discusses the "factor of underloading" and "the character of load diagrams."

Load Line.—In the Liverpool station the maximum load in winter is said to be 100 times greater than the minimum load in summer.

Central Station Measurements.—A short discussion of Dr. Kallmann's article, mentioned before in these columns, is given in the "Elek. Zeit." Jan. 18.

Accounts.—The Lond. "Elec. Rev.," Jan. 26, publishes abstracts from the accounts of several English electrical companies.

Electrical Effects at Theatres.—The Lond. "Elec. Eng.," Jan. 19, publishes three full-page illustrations of some striking effects at the Lyceum and the Drury Lane theatres in London, which effects are spoken of very highly in that journal, as also in the Lond. "Elec. Rev."; among the effects in the pantomime of "Cinderella" may be mentioned the fairy slippers, the fire scene, the carriage, the floral sprays and the scent bottle, all of which are lighted with electric lights, producing various effects; at the Drury Lane Theatre may be mentioned the fish ballet, in which each of the dancers is decorated with 4-volt lamps, supplied by a 2-cell lithanode battery of one ampere hour; a short description of the electrical arrangements is given in these two journals.

London.—The Lond. "Elec.," Jan. 19, publishes its yearly supplement of a map of London, with the various lighting districts in different colors, showing mains actually laid up to the beginning of this year.

London.—The Lond. "Elec. Eng., Jan. 26, gives a brief description, with a number of illustrations (limited entirely to the architectural features), of the electrical light installation at the Great Eastern station.

Huddersfield.—A profusely illustrated description of this station is given in the Lond. "Elec. Eng.," Jan. 26; the high-tension alternating system, with low-tension distribution, is used; the plant was installed by the English Brush Company.

WIRES, WIRING AND CONDUITS.

Resistance of Stranded Cables.—The Lond. "Elec. Eng.," Jan. 26, contains the first portion of an article by Mr. Everett, in which he discusses mathematically the calculation of the resistance of a stranded conductor; taking first one layer, he deduces a quantity by which the current that would exist if all the wires were insulated from one another must be multiplied in order to find the true current; he shows that contact between contiguous layers (which are always wound in opposite directions) does not increase the conductivity of

the whole conductor, but on the contrary diminishes it, but this factor is probably almost, if not quite, negligible.

Rules for Insulation Resistance.—A correspondent to the Lond. "Elec.," Jan. 19, in commenting on the rules regarding insulation published in that journal last week, states that the voltage was not taken into consideration in any of the rules, and that the number of lamps, irrespective of their candle power, should be taken into consideration, as they practicaily govern the surface leakage due to switches and cut-outs; for a rule he suggests to divide the voltage of the lamp by the number of lamps, and letting the result represent the insulation resistance in megohms; curves are given showing the results for lamps of three different voltages; in addition there should be a maximum and minimum, for which he suggests 5.0 and 0.1 megohms respectively. Editorially the journal adds that this rule, although simple and practical, can hardly be said to be the average of modern practice, as the resistance obtained thereby appears to be about double; half the volts, divided by the number of lamps, corresponds better with the rules in practice.

A correspondent to the Lond. "Elec.," Jan. 26, suggests that if the voltage is taken into account in any general formula for the allowable insulation resistance of house wiring, the minimum values for alternating currents should be raised 50 per cent. above those for continuous currents, because the maximum voltage is approximately 1.4 times as great. Editorially that journal suggests that as far as the leakage current is concerned, a lower insulation might be allowed for alternating currents, as the electrolytic action will probably be less.

Insulation.—In Mr. Guy's serial in the Lond. "Elec. Eng.," Jan. 26, he discusses the subject of insulation; a table is given of the specific insulation and other data of the electric light cables of various companies.

Increasing the Safety of High-Tension Distribution.—A translation of the article by Mr. Claude mentioned in the Digest last week is given in abstract in the Lond. "Elec.," Jan. 19, in which the cuts are also reproduced. In an editorial comment it is stated that the mains thus protected behaved like a Leyden jar, which, although very highly charged, may nevertheless be touched at one pole without danger, provided the whole jar is insulated from the earth; the mains, when thus protected, behaved as if there were no capacity effect to earth, and they can therefore be touched without danger, provided they are not connected to earth by a leak having no appreciable self-induction; it is thought to be probable that high-potential mains will be kept connected permanently to the earth in this manner; the expense of the coils would be very great.

Impedance of Aerial Lines.—The article by Mr. Hospitalier, abstracted last week, is translated and published in the Lond. "Elec. Eng.," Jan. 19.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphy and Telephony in the United States and England.—See under Miscellaneous the paper by Mr. Preece headed "Electricity in the United States."

ELECTRO-CHEMISTRY.

Electro-Chemical Effects on Magnetizing Iron.—The Lond. "Elec. Rev.," Jan. 19, reprints an abstract from the proceedings of the Royal Society by Mr. Andrews under this heading. Experiments are briefly described in which opposite poles of two bar magnets were connected by an electrolyte, and it was found that the north terminal became electropositive and the south pole negative; on first immersing the bars a momentary current was noticed, the direction of which was opposite to that of the subsequent steady current; the E. M. F. steadily increased; the average was 0.014 volt for the upper ends of the vertical magnets and 0.011 for the lower ends; Prof. Stokes suggested that it might be due to the earth's magnetic force, which strengthened one of the poles and weakened the other, and it is stated that the difference in the above E. M. Fs. may possibly be due to this cause; "in the case of copper salts the ratio of the electrodeposition of the copper was apparently affected by these magnetic influences."

Electrometallurgy.—In an article in "Ind. and Iron," Jan 19, on metallurgical progress in 1893, the electrochemical extraction of gold, known as the Hannay electrocyanide process, is briefly described, as are also a few other recent electrometallurgical processes.

Silver-Plating Industry.—In the serial in "Ind. and Iron' the subjects of filtering and the weight of the deposit are discussed in the issue of Jan. 19, and the subject of differential or localized electroplate in the issue of Jan. 26.

Electrolytic Estimation and Separation.—The Lond. "Elec. Eng.," Jan. 26, abstracts briefly a paper by Mr. Vortmann from the "Monatsh."

Electrolysis of Fused Salts.—Mr. Andreoli's serial is continued in "Ind. and Iron," Jan. 26, in which he continues his summary of what has been done in this field; several forms of apparatus are described and illustrated.

Purification of Sewage.—A translation of the unfavorable report on the Hermite process at Havre, mentioned in the Digest last week, is given in "Ind. and Iron," Jan. 26; the process is soon to be tried at Worthing.

MISCELLANEOUS.

Electricity in the United States.—The Lond. "Elec. Eng., Jan. 26, publishes the first part of an Institution paper by Mr. W. H. Preece on "Notes of a Trip to the United States and to Chicago, 1893," and comments on it favorably in an editorial. After enumerating the various improvements in telegraphy and telephony which he found in this country on his former visits, and which he then introduced in England, he gives a very interesting description, including much data, of the telegraph in this country; a table is given of various statistics in 1884 and 1893, as also those for 1892 in Great Britain, in every item of which the figures in the United States are greater, except in the number of messages delivered, and, therefore, the cost of a message; the description does not admit of being abstracted, but some of his opinions are as follows: He states that the lines are not built as solidly nor have the Americans followed true engineering principles in the same way as the English have; as a rule, the lines are badly constructed, with poles that would not be looked at in England, but some of the trunk lines of the telephone companies and the new trunk line of the Postal Telegraph Company compare very favorably with the best modes of construction in England; he criticises unfavorably the use of dynamos in telegraphy and greatly prefers accumulators, with which so much success has been had in England; regarding apparatus, he states having observed little or no progress, neither company having made any advance in the systems over that in 1884; the working of the Wheatstone system between New York and Chicago, he says, is admirable, and the number of messages handled in a day on this circuit "is certainly astonishing," being 4,211 messages on one circuit in a day, "a number that we can scarcely hope to rival"; but this, he adds, is not due to speed, which is less than in England, but to the fact that the business day is longer. His conclusions regarding telegraphy, in which he makes a comparison, are given in full in another column of this issue. Regarding telephony, he states that gigantic strides have been made since 1884, which he shows by comparative statistics; the advantage of the telephone monopoly "is the establishment of a uniformity of working and practice that is highly and extremely beneficial"; he does not think the local working is any better, if as good, as that of

Newcastle-on-Tyne, but that in trunk and long-distance working the Americans are far ahead of the English.

Institution of Electrical Engineers.—The Lond. "Elec. Eng.," Jan. 19, reprints in full the conclusion of the inaugural address of Prof. Alexander Siemens; it is interesting reading, but appears to contain nothing new; progress in various directions is briefly referred to; in referring to long-distance transmission he expresses his belief that of the actually established plants the greater part are worked with continuous currents, stating that no hard and fast rule can be laid down, and that the proper conclusions can be arrived at only if the commercial aspect is allowed to decide the question. In referring to the subject of education, he says that the danger which is to be avoided in our scientific colleges is the tendency to teach our profession too much in detail, as it is apt to produce on the students the impression that on leaving college they know all that can possibly be known, and that anything that does not fit in with the theory of their pet professor must be condemned; "at school the mental powers should be principally exercised in a way to make them fit for learning; * * * after the mental powers have been prepared in this way, it is not of great consequence whether most of the details of the school teaching are speedily forgotten or not"; he advocates that teaching at engineering colleges should be confined to general principles. The Lond. "Elec.," Jan. 19 and 26, reprints this address and comments on it very favorably in an editorial; the "Elec. Rev." reprints it in abstract, and in an editorial comments unfavorably, saying that it was decidedly disappointing in many respects; the editorial dwells more particularly on the comparison of American and English methods.

Educational.—See the above abstract.

Technical Education.—The Lond. "Elec.," Jan. 26, reprints an article from "Engineering," Jan. 19.

Gutta-percha.—The Lond. "Elec.," Jan. 19, publishes an article from "Ann. Teleg.," by Mr. Lagarde. He gives an analysis of the gutta-percha extracted by the Serullas process from the leaves of the isonandra (the process was described in the Digest March 25; see also April 29); the analysis showed the following: Water, 0; impurities, 0.8 per cent.; fluavil, 1.72 per cent.; alban, 14.28 per cent., and gutta-percha, 83.2 per cent.; he accounts for the high specific insulation by the amount of alban as compared with fluavil, and especially to the absence of water; he is inclined to think that on account of the absence of water this gutta-percha will oxidize less rapidly and will consequently last longer; the resins (alban and fluavil), especially alban, increase the insulating power, but are a source of deterioration; analysis, he believes, is the only means of discovering whether the gutta-percha in a cable is of good or bad quality. Regarding the question whether pure gutta-percha from different sources has identical qualities, he considers that the best way to test it is to reduce it to very fine sheets and make condensers of it.

Liquid Air.—Prof. Dewar's lecture on "The Scientific Uses of Liquid Air" is abstracted in the Lond. "Elec. Eng.," Jan. 26; the parts of special interest to electricians are abstracted elsewhere.

Cause of Electric Currents in Plants.—The Lond. "Elec. Eng.," Jan. 26, abstracts an article by Mr. Haacke on this subject.

Time in Psycho-Physiological Phenomena.—"La Lum. Elec.," Jan. 20, contains a long illustrated article by Mr. Henry on this subject.

Central Station Currents in Therapeutics.—"La Lum. Elec.," Jan. 20, abstracts a paper by Mr. Gaiffe, in which he reviews the subject, but gives apparently nothing new.

Electricity and Artillery Practice.—The Lond. "Elec Rev.," Jan. 19, contains an editorial on this subject, calling attention to it as a new field of enterprise.

National Laboratories.—A translation of the article by Mr. Guillaume, mentioned in the Digest last week, is published in Lond. "Elec.," Jan. 19.

Biographical.—The Lond. "Elec.," Jan. 26, publishes a short biography of Alexander Siemens, together with a supplement in the form of a large steel-plate portrait.

Werner von Siemens.—The Lond. "Elec. Rev.," Jan. 19 and 26, publishes under the heading "A Pillar of Science" an abstract from the English translation of the book "Personal Recollections of Werner von Siemens."

From the Capital of Pennsylvania.

It is indisputable that this is the electric age, hence to be up with the times it is advisable to keep posted on the advance in matters electrical. This cannot be accomplished more easily than by perusing The Electrical World.

—Harrisburg Call.

An Opinion from the City of Churches.

That magnificent journal, The Electrical World, is a marvelous illustration of what can be done in these days in furnishing the earliest, the fullest and most accurate information on the subjects of which it treats. There is no department of human knowledge to-day in which intellectual minds are more interested than in electricity, and no serial has as yet appeared in which they can find more to engage their attention. The articles bear evidence of high mathematical attainments united with fine literary ability. The Electrical World, having been established nineteen years ago, may be said to have kept pace with the science of electricity in all its later and most wonderful achievements. It is printed on fine super-calendered paper, profusely and beautifully illustrated, and furnished to subscribers at the insignificant price of $3 per year, including postage.

—Brooklyn (N. Y.) Blade.

Unipolar and So-Called Unipolar Dynamos.

A correspondent, referring to a recent article in our columns on unipolar machines, asks us to explain why the Ball dynamo generates a current with only a single pole piece. Although this question has been asked and answered many times, we will say again that this dynamo is not really a unipolar machine in the true sense of the word. A true unipolar machine is one in which the *induction* is unipolar, or more popularly speaking, in which the current always flows in the same direction in the armature wire, and therefore does not need to be reversed at every half revolution of the commutator. The very fact that the Ball dynamo has such a commutator, shows that it is not a true unipolar machine. A simple exploration with the compass needle will show that there is a true magnetic pole diametrically opposite to the pole piece; it might be said that this second invisible pole piece was made of air. A less attractive but more correct name for this machine might be "a unipole-piece bipolar dynamo."

To say that a unipolar machine has only one magnetic pole is absurd, as every line of force or magnetic field has two opposite polarities at any two points in the direction of the flux. The machine may have only one *pole piece*, but there will always be a second *pole* somewhere, even though there may not be a pole piece; even every true unipolar machine must have two magnetic poles.

Mr. Preece's Comparison of the Telegraph in the United States and in England.

In a recent paper by Mr. William H. Preece, of London, on "Notes of a Trip to the United States and to Chicago, 1893," he gives a very good description of the telegraph in the United States, a reference to which will be found in our Digest. After this description, he summarizes his conclusions as follows:

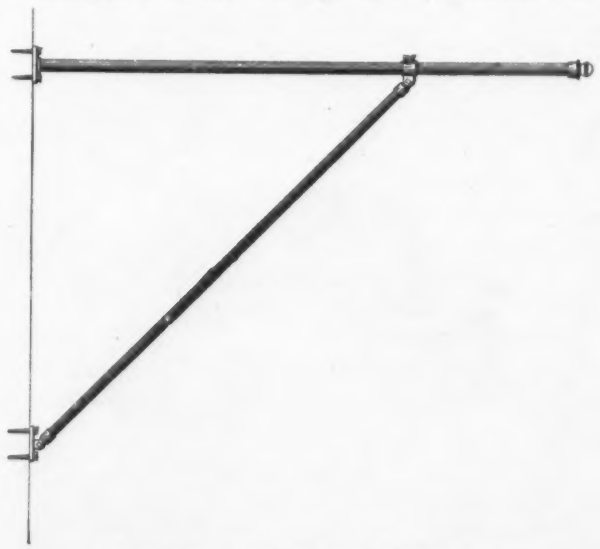
"It is quite impossible to inspect the telegraph system of the United States and compare it with our own system without drawing comparisons between the way in which the work is done in the two countries. The result of my previous visit was to confirm my view that we do our work better in England than they do in the States. Our apparatus is better, our speed is higher. Messages are handled with greater reliability. A message can be sent and its reply received with certainty in an hour in England. I fancy such rapidity would astonish the users of the telegraph in the States, except those in such busy centres as New York and Chicago, and generally the speculative branches of the community. The domestic telegram scarcely seems to have reached the United States, and this is owing probably to the fact that the districts of private residences, the small towns and the villages do not possess telegraph offices, unless they are supplied by the railway company at the railway station, or by the Western Union Company, who do the work for the railway company. I fail to see any superiority in the manipulative skill of American operators. They certainly have not made the same advance in technical education that we have, and altogether it may be said that the management of the telegraphs in the hands of private enterprise does not compare favorably with the management of the telegraphs by the state at home. At the same time, it must not be assumed because the government has advantageously taken the telegraphs in hand at home that such a process would be possible in the States. In my opinion, it would be absolutely impossible. The civil service of the United States is in a very chaotic condition. The principal appointments are four-year appointments only, and are filled politically. The principal postmasters come in and go out with each new president. We in England scarcely consider that a postmaster is fit to be a postmaster until he has had many years' experience in the working of the post office system. In the States a man is made a postmaster because he has been a political supporter. At one or two offices I found the new post office officials absolutely ignorant of simple facts they ought to have had at their fingers' ends. A business like that of telephones or telegraphs can only be conducted properly by those who possess a considerable amount of enterprise, and who look primarily to the necessities of the community. The reason why our post offices and our telegraph offices at home work so well is because the public exercises such a useful and such a determined supervision over the work. The free opening of the press to complaints; the readiness with which members of the House of Commons ask questions—though at times, perhaps, irritating and vexatious—are undoubtedly good for the service, for they keep us all alive. Such a state of affairs is impossible in the States. The government of the United States must first reform its civil service, and when it gets officials into the service whose tenure of office is secure, and whose zeal is as unquestioned as it is in England, then there will be some chance of their government acquiring the telegraphs; but under existing circumstances, the acquisition of the telegraphs by the government of the United States would amount virtually to the deterioration of the service. The commercial management is at present, as I have pointed out, characterized by great energy. I do not, however, acknowledge that they show greater energy than we do in England. Competition may make it more conspicuous, but it is not more reaching. Our speculative business, stocks and racing is done as well as theirs. The management at home is characterized in all particulars with similar energy to that which I observed in the States; and I come back without any views or wrinkles which I think could be impressed with advantage on the commercial or technical management of our system at home, unless it be the encouragement of offices in hotels, for it is found everywhere that a telegraph office at one's door prompts the desire or want to telegraph. The capital of the Western Union Company was in 1877 $22,000,000; that of the British Post Office was £10,000,000. The capital of the former is now $123,000,000, while that of the latter remains virtually the same. Scarcely a single vestige of the old telegraph companies' systems purchased by the state in this country now remains. Whence, therefore, this splendid system of cables, underground lines and new pole lines in this country, spreading everywhere, and transacting an annual business of £2,500,000, instead of the £600,000 handed over to us? It has all been paid for out of revenue! The government keeps no capital account. How do we do our work? The proof of the pudding is in the eating thereof. The criterion of telegraph working is rapid dispatch. 'Time is our only competitor,' said Dr. Norvin Green. The time occupied in its transit from the hands of the sender to those of the receiver is the pudding. The whole of the messages arriving in Newcastle on the morning of Jan. 20 were examined and analyzed. The mean time of transit from all parts of the United Kingdom averaged 7.8 minutes. A similar examination at Glasgow on Jan. 15 gave a mean result of 8.7 minutes. This cannot be beaten, and it certainly will not be believed. The late Mr. Patey was once asked why express telegraph service at higher rates was not introduced in England. His answer was: "All our messages are expressed already.'"

An Acknowledgment from a Competitor of the Electric Light.

"In recounting the history of electric lighting for the past year," says the "Journal of Gas Lighting," "it is better to begin by acknowledging that this industry has made a certain amount of progress."

Iron Pipe Trolley Bracket.

We illustrate a strong and light trolley bracket made by



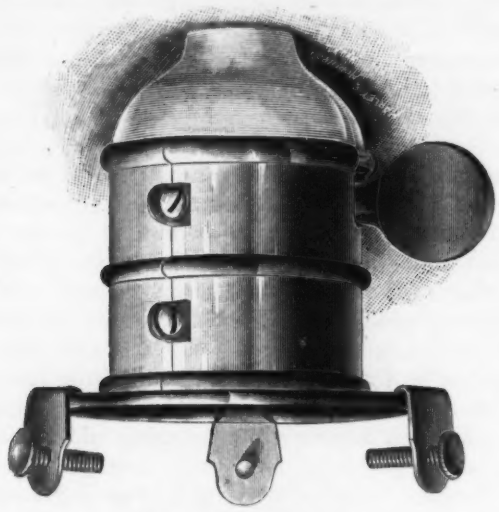
IMPROVED TROLLEY BRACKET.

James R. Gwilliam, 115 North Sixth street, Philadelphia, which is easily erected, being put together with bolts and

nuts. The horizontal arm is of 1 1-2 inch, and the brace of 1 inch wrought iron steam pipe. The principal fittings, which take the strain, are of malleable iron. The bracket is adjustable, so that the horizontal arm can be kept level, regardless of the contour of the pole. The brace is fastened to the horizontal arm by two cup-pointed set screws.

A Cord Lamp Socket.

The cord socket, manufactured by the Newton Electric Company, of 39 and 41 Cortlandt street, as shown in the cut,



CORD LAMP SOCKET.

consists of a porcelain base, on which the terminal pieces, or clamps, are mounted, the spring clamp making direct contact against the inner shell. The porcelain base dispenses with the necessity of an insulating bushing, and the whole socket has in it but four screws. In appearance it is light, but the strength of it is so well placed that additional metal would be unnecessary. This statement also applies to the holder, but a 5-pound shade can be suspended from it without any danger whatever.

The cord pendant this company has just put on the market is made up of a standard rosette, six feet of cord and one of their sockets, as described above, with holder.

Improved Shade Holders.

Those who have had experience with the older forms of shade holders will appreciate the one we illustrate, manufactured by the McCreary Electrical Specialty Company, 136 Liberty street, New York, which has no screws or loose parts to drop out and besides is of a handsome appearance.

Fig. 1 shows the holder complete ready to be attached to

FIG. 1.—SHADE HOLDER.

an Edison socket. The neck of the holder, which is of stiff spring brass, fits over the ring on the Edison socket, and is held firmly so that it is moved only with the socket. In Fig. 2 the holder is shown with clasp ready to be attached to a Thomson-Houston or Westinghouse socket.

The shade holder is made of polished brass and gives a very neat finish to the fixture. It is instantly attached to the socket and as quickly removed. No tools are required, and its great simplicity is one of its good qualities. The brass is of sufficient thickness so that it is not easily injured or

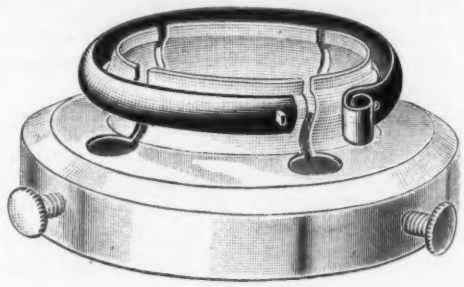
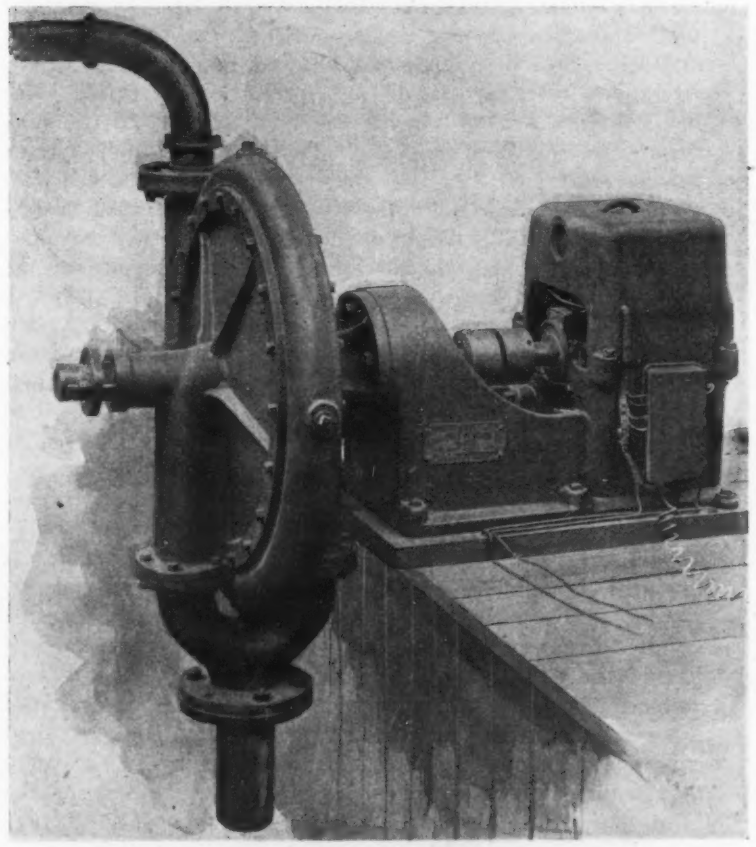


FIG. 2—SHADE HOLDER.

bent out of shape. It holds the shade firmly and still gives abundance of room for the top of the shade.

Electric Centrifugal Pump.

Among the many types of electric pumps exhibited by the General Electric Company in its power and mining section at the Chicago Exposition, the electric centrifugal pump, ejecting its broad stream of water into the reservoir in Electricity Building, attracted considerable attention.



CENTRIFUGAL PUMP.

The pump itself is a No. 4 4-inch centrifugal pump, manufactured by the Lawrence company. The shaft of the pump is directly connected to the shaft of the armature of a General Electric ironclad No. 2 1-2 W. P. motor, running at 400 revolutions, at which speed it developed 3 h. p.

This pump is intended for use where muddy or dirty water is encountered, which would quickly destroy the usefulness of the valves of an ordinary pump. It has proved remarkably efficient wherever it has been used, especially in raising water for irrigation purposes.

New Books.

A STANDARD DICTIONARY OF THE ENGLISH LANGUAGE. Upon Original Plans. Prepared by More Than Two Hundred Specialists and Other Scholars, Under the Supervision of Isaac K. Funk, D. D., Editor-in-Chief. Volume I. New York: Funk & Wagnalls Company. 1893. 1,060 pages. Price, complete, Russia binding, $12.00.

There are two methods of treating words, first, the lexicographic, where the source of derivation, etymology, etc., are the chief ends in view, and, second, the encyclopaedic, in which the things of which the words are the names, or to which they apply or pertain, are the chief ends. The work under consideration is intentionally constructed with the encyclopaedic features as the primary object, and the lexicographic features as a secondary consideration, in the belief that this method will enhance its value as a popular work. In the lexicographic features it is somewhat inferior to Webster's, but in the encyclopaedic features it is for the most part superior.

We will note, however, in passing a single instance from the exceptions to the latter rule. Brachistochrone is given instead of the brachystochrone of the older dictionaries, which is an improvement for etymological reasons, but the definition fails to state that the brachistochrone is the same as the cycloid. This information is given by Webster, and for the most part by those dictionaries that define the word at all, and is moreover one of the most important things to be said about the curve.

The etymology of the word electricity is given as derived from the Latin electrum, which is derived from the Greek elektron. This is in accordance with the older dictionaries, but there has been some discussion during the past year as to the real value of this etymology, and it is of some interest to know that this new dictionary supports the older ones. Both electricute and electrocute are given as correct, which would seem to settle the matter, but to many electricians this uncouth word has been from its inception as unwelcome as the act to which it applies.

Hysteresis is defined as "Molecular friction due to magnetic change or stress; that property of a medium by virtue of which work is done in changing the direction or intensity of magnetic force among its parts." This is very nearly the idea conveyed by most of the definitions of hysteresis given by others than the author of the word, Prof. Ewing. It is, however, incorrect for molecular friction, for, although it may be considered as the cause of hysteresis, it is not identical therewith. We do not wish to stand for hair-splitting distinctions; to our mind there is an important and fundamental difference. A wire may be heated red hot by the passage of an electric current, but no one would in consequence of this fact think of calling a red hot wire an electric current, and yet the offense against the rules of language and the principles of physical science in so doing would be no greater than that contained in the foregoing definition of hysteresis. Immediately after this definition is given the following quotation, in which the word hysteresis is properly used: "The permeability varies enormously with the amount of magnetizing force, and in a manner desperately complicated by magnetic retentiveness, hysteresis according to Ewing's designation. William Thomson, Math. and Phys. Papers, volume III., Article CI., page 478 (C. P., '90)." The best short definition of hysteresis is that just quoted; magnetic retentiveness. It is the tendency of iron (or other magnetic substance) to persist in any given state of magnetization. That is, if it is unmagnetized it resists magnetization, and if it is magnetized it resists demagnetization. There are analogous phenomena in other cases, so that the meaning of the word hysteresis has been broadened of late to include the whole class, and is often used with a qualifying adjective as magnetic hysteresis, dielectric hysteresis, etc.

The electrical vocabulary is very full, containing conductance, impedance and other coins from Mr. Oliver Heaviside's mint. The practice of giving exact references to book and page, and even paragraph, in some cases, for quotations in illustration of the proper use of words, which is carried out in this work, is certainly commendable.

The mechanical get-up of the work is excellent. The paper is of a good quality, the typography clear and the binding is handsome and substantial. There are six full-page colored plates (two of which, those for birds and gems, deserve special mention), and an abundance of other illustrations. For its size and price it is probably the best dictionary in the English language.

THE ELECTRIC TRANSFORMATION OF POWER, AND ITS APPLICATION BY THE ELECTRIC MOTOR, Including Electric Railway Construction. By Philip Atkinson, A. M., Ph. D. New York: D. Van Nostrand Company. 1893. 244 pages, 96 illustrations. Price, $2.

The author in his preface states that the design of this book is to give, in plain, untechnical language, the means by which electricity is employed as an agent for the transformation and transmission of power, and its application to the operation of machinery.

This book is in many respects a typical compilation, and one in which the text was apparently determined to a great extent by the collection of cuts made from trade and other sources, and then written up to. For example, descriptions of two electric elevators occupy more space than is devoted to the entire subject of alternating-current motors, the space given to electric drills is but little less, and a description of a deck hoist is of about the same length as that of the Liverpool and of the City and South London electric railways together.

While the book is thus mostly a compilation and its contents apparently largely written up to the cuts available, evidence is everywhere given of care in statement and a desire to present the material in such a manner as to be most easily comprehended by the reader. The descriptions are good and, in this respect, unlike most compilations, the reader will not be misled by the information given. For the general reader and the first year student of electrotechnics the work will be found useful, and statisfies a real need in this respect.

A TEXTBOOK ON ELECTRO-MAGNETISM AND THE CONSTRUCTION OF DYNAMOS. Vol. I. By Dugald C. Jackson. New York: MacMillan & Co. 1893. 289 pages, 132 illustrations. Price, $2.25.

In the preface the author states that the primary object in publishing this work is to supply a satisfactory textbook to be used as the basis of instruction to college classes, and it can be said that this object has been admirably attained. While the great condensation of matter and omission of minor explanations and details may render the work somewhat difficult to the unassisted student, this objection does not apply when it is used as a college textbook, and is even an advantage to the professional engineer, who would refer to such a work for information on important principles, which he will find here developed without an incumbrance of details unnecessary to him.

Chapter I. is introductory and deals with primary definitions and evaluations. The discussion of magnetic potential and force is very satisfactory, the special cases developed assisting very greatly to the conception of the important principles concerned. Chapter II. is on simple electromagnets, in which some of the more important principles of their design are treated at length. Chapter III., on the magnetic properties of iron, describes different methods of determining curves of magnetization and permeability, of which curves a large number are illustrated, and the magnetic properties of different irons, steels, etc., are discussed in a thorough manner and with a distinctly practical bearing.

The subject of hysteresis is also treated in this chapter in a clear and satisfactory manner.

The first part of Chapter IV. is on electro-magnetic induction with reference to dynamos, the treatment of which subject does not differ materially from that given in other books, though the representation of Siemens' winding, adopted by the author, is different and much less satisfactory than the one usually employed. The remainder of the chapter, on armature losses and calculations, brings out the various points connected with these subjects clearly and with particular reference to their practical bearing, which, it may be here said, is a characteristic of the book throughout. The principles relating to the magnetic circuit of the dynamo are developed in Chapter V., particular attention being paid to the subject of magnetic leakage. Examples of calculations of field windings are given, toothed versus smooth armatures discussed, and the subject of armature reactions introduced. Chapter VI. is on the compensation for cross turns and the effect of brush contact, and thoroughly explains the Sayre and Ryan devices to accomplish the former, and refers to other methods of reducing sparking.

Chapter VII. is on characteristic curves and their determination and on regulation, the latter being treated with reference to characteristics and the principles laid down for the different kinds of windings and classes of dynamos. The latter part of the chapter deals with connecting dynamos for combined output, in which this important subject is more thoroughly considered than in any other work of which we know. Chapter VIII., on efficiencies, might, we think, be given a greater value if the absolute practical worthlessness of electrical efficiencies for even the purpose of comparisons were pointed out, and the effect on commercial efficiency of change in speed and design for a given output explained at length. Methods of separating the various factors that enter into efficiency are given and the variation of efficiency with weight, cost and output discussed. The final chapter is on multipolar dynamos, or rather is a discussion of their advantages and disadvantages.

We have no hesitation in recommending this work as the best, within its compass, of any yet published on the important subject of which it treats. While primarily intended for a college textbook, the electrical engineer will find it of value, not only in bringing his knowledge up to date, but as a reference book on a number of the most important points in dynamo design.

L'ANNUAIRE DU BUREAU DES LONGITUDES POUR 1894. Paris: Gauthier-Villars et Fils. 886 pages with two magnetic charts. Price, 1 fr. 50.

Besides the practical information which this valuable annual contains each year, the present issue has articles by authorities on coinage, statistics, geography, mineralogy, etc., and the following special articles: Light and Electricity, according to Maxwell and Hertz, by M. Poincare; The Origin and Employment of the Mariner's Compass, by Rear Admiral Fleuriais; Four Days of Observation on the Summit of Mont Blanc, by Prof. Janssen. There are also funeral discourses by MM. Faye, Bouquet de la Grye and Rear Admiral Fleuriais on Admiral Paris, and addresses delivered at the unveiling of the statue of Arago, by MM. Tisserand, Cornu and Mouchez.

FIRST PRINCIPLES OF ELECTRICAL ENGINEERING; Being an attempt to provide an Elementary Book for those who are intending to enter the profession of Electrical Engineering. By C. H. W. Biggs. New edition, partly re-written and extended. London: Biggs & Co. 1893. 260 pages, 152 illustrations. Price, $1.00.

If the term "electrical engineering" is understood in England as in America, we should say that the title of this little volume is most decidedly a misnomer, or, if it can there be properly called a treatise on the first principles of electrical engineering, then that profession has there a much more limited application than in this country. Electrical distribution, for example, is disposed of in about eight small pages of text, and but little more space is given to electrical measurements, or the two together occupy about the same space as static machines and voltaic cells. On the other hand, the book will be found a very satisfactory elementary work on general electricity and magnetism, and particularly on those parts dealing with electro-magnetic induction and circuits. A valuable feature of the book is that the academic method of treatment is avoided, the various phenomena and principles being explained by reference to concrete examples and accompanied by comments having a practical bearing.

THE SCIENCE OF MECHANICS. A Critical and Historical Exposition of Its Principles. By Dr. Ernst Mach, Professor of Physics in the University of Prague. Translated from the second German edition by T. J. McCormack. Chicago: The Open Court Publishing Company. 1893. 534 pages, 235 illustrations. Price, $2.50.

The present volume, says the author in the preface, is not a treatise upon the application of the principles of mechanics. Its aim is to clear up ideas, expose the real significance of the matter, and get rid of metaphysical obscurities. The little mathematics it contains is merely secondary to the purpose.

Mechanics will here be treated, he continues, not as a branch of mathematics, but as one of the physical sciences. The positive and physical essence of mechanics, which makes its chief and highest interest for a student of nature, is in existing treatises completely buried and concealed beneath a mass of technical considerations. Here is taught how the principles of mechanics have been ascertained, from what sources they take their origin, and how far they can be regarded as permanent acquisitions.

To the teacher this work should be of value in showing the growth of various ideas, their different mutations and their interconnection with other ideas, thus enabling him to appreciate their difficulties and also to arrive at the natural method by which to impart them to others. By this method a principle becomes a thing of life with a personal history connected with the great names of science, and is thus infinitely more interesting than if stated as a mere abstraction, with no reference to what we may call the human process, by means of which it became established.

At the end of the volume the author gives a list of great masters of all time who have built up the science of mechanics, and whose ages seem to indicate that this science is especially conducive to longevity. Of the 42 names, two lived to be over 85 years, seven between 70 and 75, five between 65 and 70 years, and five between 60 and 65 years, while only 11 died younger than 60 years, among whom are numbered four of the greatest names, Descartes, Keppler, Pascal and Torricelli, the latter two having died at the early ages of 39 and 37 respectively.

The National Electric Light Association.

We are informed by Mr. C. O. Baker, Jr., master of transportation, that the concession of a fare and one-third to the Washington convention has been received from all sections of the country except that portion west of the Mississippi and north of Chicago, Peoria and Burlington, the cities named being included in this rate. Negotiations are being made with the Western Traffic Association, and it is hoped that a concession may be secured from them. The following gentlemen will have charge of transportation matters in their respective sections: A. C. Shaw, Boston, Mass.; C. F. Hesser, Cincinnati, Ohio; H. A. Cleverly, Philadelphia, Pa.; E. H. Heinrichs, Pittsburgh, Pa.; M. J. Sullivan, Chicago, Ill.; James I. Ayer, St. Louis, Mo.; E. R. Weeks, Kansas City, Mo., and W. W. Borst, Denver, Col.

Financial Intelligence.

The Electrical Stock Market.

NEW YORK, Feb. 10, 1894.

GENERAL ELECTRIC STOCK, as a result of being heavily undersold, shows a tendency to rise, from which much is presaged by the friends of the stock. The short interest is understood to be particularly large in Boston, and the stock is so scarce there that it is impossible to borrow 100 shares without paying a good round premium. Efforts have been made by the people working for lower prices to again spread the old report of a lack of harmony between President Coffin and other officials, but the "officials" hasten to hush this up as quickly as ever. Insiders make very cheerful statements just now. Drexel, Morgan & Co. say: "We are paying nq attention to fluctuations, but, so far as General Electric is concerned, all that is to be told is this: The machinery, brains and necessary capital are there; when business improves, so that the question of ordinary expenses will not be considered, the General Electric Company will be in a flourishing condition—and a dividend paper." An official of the company, speaking about its business, says: "Our company has been receiving new work steadily of late, almost wholly in the railway department for motors, the orders on hand at the moment calling for about four hundred. The orders are not from any one source, but come from various roads over the country. The force employed on the regular pay roll is between 1,500 and 1,600 hands. The new work may necessitate the employment of some extra labor. On the whole, this improvement is expected in the early spring, and is not unusual." In order to reduce expenses, the several departments in Lynn will be consolidated in one or two buildings. A new general manager, Mr. G. E. Emmons, formerly auditor at Lynn, is now in charge of the factory there. He replaces Mr. Rice, who has taken charge of the Schenectady plant. There was a meeting of the directors of the company some days since, at which Mr. J. P. Ord was chosen second vice president, General B. F. Peach, treasurer, with Henry W. Darling as first assistant and C. G. Arnedberg as second assistant. Mr. Ord, as vice president, will have charge of the treasury, credit and accounting departments. The local officers of the company state that, as far as they are aware, General Electric was not a creditor, as stated, of the Nashville, Tenn., Electric Railway, which made an assignment this week with liabilities of $1,000,000. The books which would show the exact facts have been removed to Schenectady. This is another proof of the removal of departments from New York. Only the president's and treasurer's offices are now in this city.

WESTINGHOUSE ELECTRIC MATTERS are attracting a deal of attention just at present. Several items, of which exclusive announcement was first made in these columns, received official confirmation this week. Mr. Geo. Westinghouse himself substantiates the statement first made public in these letters two months ago, to the effect that the big World's Fair plant is to be installed here. Eight of the twelve dynamos exhibited by the Westinghouse Electrical Company at Chicago last summer, together with two additional ones, which have just been completed at the Pittsburg shops, are now on their way to this city, where they will be installed in the United Electric Light and Power Company's building for immediate use. The four remaining dynamos of the big World Fair's plant are to be sent to Baltimore for the Brush Electric Light Company. It is now announced that Mr. Westinghouse may have constructed at his residence, near Pittsburg, Pa., a private railroad one-quarter of a mile long for the purpose of conducting experiments with his new third rail system of electric railway. Mr. Westinghouse himself is responsible for the prediction that it will revolutionize present methods of street car propulsion. Work has also been begun on the new shops, mentioned not long ago, for the Westinghouse Electric and Manufacturing Company at Brinton, near Pittsburg. The first buildings, to cost about $500,000, to be built are the machine shop and the warehouse. The new buildings will allow of the consolidation of departments and consequent great saving in operating expenses. These many favorable factors have created a deal of bullish sentiment on the stock, and its quotations are well held and steady. An early advance is also predicted.

WESTERN UNION TELEGRAPH stock at times this week almost monopolized stock market transactions. Selling of the stock has been on a scale large enough to confirm every one's suspicion that only inside sources could supply the large blocks of shares so freely offered. Of course the whole trading fraternity has hastened to participate in the bear campaign, with the result that no single stock on the whole Stock Exchange list is as heavily oversold, and a reaction of a couple of points consequent upon a scaring of shorts to cover would not be a bit surprising. It is true that the company's earnings are falling off at a great rate. As compared with last year a decrease of $200,000 a month is being recorded. The March quarterly report is expected to show a decrease in gross earnings of 33⅓ per cent., but a saving in expenses may pull up net earnings a little.

AMERICAN BELL TELEPHONE matters do not bear exactly a rosy hue just at present. Already no less than five bills relating to telephone matters are now pending in the Massachusetts Legislature providing for increased taxation and lessened telephone rentals, while at Albany a bill has been introduced fixing the maximum telephone charges at $50 annually. Adverse legislation of a similar character is also threatened in other States.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	95	96
" " " 1sts	—	105¼	105½
Edison Electric Ill., Brooklyn	100	99	100
" " " Boston	100	112	115
" " " Chicago	100	145	150
" " " Philadelphia	100	115	120
Edison Electric Light of Europe	—	—	3
" Bonds	—	80	85
" Ore Milling	—	5	12
Fort Wayne Electric	—	4	6
General Electric Company	100	35⅞	36
" " " deb. 5's	—	72	74
Interior Conduit and Ins. Co	100	20	30
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	45	47
" " " pref.	50	26	27
Western Union Telegraph	—	82¾	83

New Incorporations.

THE BILOXI ELECTRIC LIGHT COMPANY, Biloxi, Miss., capital stock $18,000, has been formed to construct and operate an electric light, heat and power plant, telephones, street railways, etc. E. G. Burklin, E. Gennan, J. W. Swetman, J. J. Semon, J. Buck, S. Sopez, W. A. White, H. T. Howard, C. E. Theobold, J. Bradford, S. Bradford, L. Bradford, J. Welder, C. Redding and W. K. M. Dukate are all interested.

THE HAZLEWOOD ELECTRIC COMPANY, Pittsburg, Pa., capital stock $20,000, has been formed to supply light, heat and power by electricity. T. M. Jenkins, H. O. Hornberger and W. A. Haller, Pittsburg, Pa., are the promoters.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
16 and 18 TIMES BUILDING, NEW YORK, Feb. 10, 1894.

THE NEW YORK-PHILADELPHIA electric railway project is again being discussed by the daily press, but no new facts are brought forth.

BROOKLYN, N. Y.—The applications for franchises of the Kings County Electric Light and Power Company and the New York State Electric Light and Power Company were referred to a special meeting, when they will be given a public hearing.

SPRAGUE, DUNCAN, HUTCHINSON & CO. have been appointed consulting engineers in connection with the electrical plant for the new Congresional Library Building at Washington. This will be one of the most important isolated installations in America, comprising over seven thousand lights.

THE NEW YORK ELECTRICAL SOCIETY will hold its next meeting at Columbia College, Forty-ninth street and Madison avenue, New York, on Thursday, Feb. 15, at 8 P. M. Mr. Joseph Sachs will deliver a lecture on "Electric Canal Boat Propulsion, With Special Reference to the Erie Canal."

MR. A. L. DANIELS, sales agent for the Miamsburg Electric Company, Miamsburg, Ohio, was in New York last week in the interest of his company. Mr. Daniels reports the sales of the Burnley cartridge battery and the Imperial dry battery as far in excess of the corresponding time last year.

MR. HARRY W. COLBY has opened an office in the Central Railroad Building, Liberty and West streets, for the Holtzer-Cabot Electric Company. Mr. Colby was formerly selling agent for the Mather Electric Company and the General Electric Company. This office will look after all motor and dynamo work outside of New England.

THE CLARK ELECTRIC COMPANY has issued an unusually handsome catalogue devoted to its well known arc lamps, dynamos and apparatus. Excellent engravings are given of ornamental arc lamps and of the Clark arc lamp for alternating circuits, which is especially adapted for interior lighting on account of possessing the valuable property of being noiseles.

A QUEER ELECTRICAL FIRM.—The New York "World" of Feb. 9 devotes considerable space to the "F. Holman Electrical Company, 128 Pearl street, New York," which for several months has been conducting a mysterious business on Myrtle avenue, near Fulton street, Brooklyn. Loaded trucks arrived and departed at all hours of the night, and various other singular circumstances were noted. Some days ago the firm decamped, and an

inspection of the building afterwards revealed about $1,000 worth of baled tobacco, which they had apparently been abandoned.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Feb. 10, 1894.

FAIRHAVEN, MASS.—J. K. Nye is looking into the feasibility of establishing an electric light plant.

A BILL has been introduced into the Massachusetts Legislature for the appointment of three telephone commissioners.

MAYOR BANCROFT, OF CAMBRIDGE, appeared before the committee on mercantile affairs of the General Court and urged action favorable to the petition of his city for permission that cities and towns be allowed to construct, maintain and lease conduits for electric wires.

THE COMMITTEE ON RAILROADS of the Boston City Council is considering the question as to whether the city should ask the Legislature to pass a law requiring the West End Railroad Company to remove all overhead wires except trolley and span wires. The Council has passed an order directing the committee on mercantile affairs to urge in the Legislature the passage of an act granting a charter to the E. Moody Boynton bicycle system, or some other form of elevated road to be built in Boston.

THE GENERAL ELECTRIC WORKS in Lynn have started up again after a week's shut down to take an inventory of stock. There are now employed in the Lynn works about 1,700 men, and the weekly pay roll is more than $16,000. The formal notification of the appointment of George E. Emmons as superintendent of the Lynn shops, in place of E. W. Rice, resigned, has been posted in the buildings. It is understood that the officers of the General Electric Company are considering the expediency of consolidating the several departments in Lynn in one or two buildings. It is likely that factories C and L will be thus utilized for most of the work. This would require that these factories be run on full time to do the work now on hand. Little or none of the machinery of the other factories will be moved.

Pittsburgh Notes.

PITTSBURGH, Feb. 8, 1894.

THE ALLEGHENY COUNTY LIGHT COMPANY is erecting a new marble switchboard in the central station building, on Twelfth and Pike streets, which, it is said, will be the finest and largest in this State.

GROUND WAS BROKEN yesterday for the new works of the Westinghouse Electric and Manufacturing Company at Brinton Station, on the Pennsylvania Railroad, and 200 men were started to work on the excavation of the machine shop, which is to be the largest of the buildings.

THE BOROUGH OF HOMESTEAD, about ten miles up the opposite bank of the Monongahela river from Pittsburg, is bound to have all the electric rapid transit facilities needed. The borough council met last night and gave franchises for entering the borough limits to four different street railway companies.

LOCAL ELECTRIC MEN are evincing a great deal of interest in the coming convention of the National Electric Light Association at Washington D. C., this month, and a large attendance is expected from here. Special transportation facilities have been promised by Mr. E. D. Smith, the district passenger agent of the B. & O. R. R. Co., in the shape of Pullman cars.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY is now making the "Sawyer-Man stopper lamp" at its own glass furnace in the Pittsburg Exuosition Building. The operation of this glass works was commenced yesterday with one "shop," and the men engaged will only make lamp bulbs and stoppers. The place is in charge of Mr. L. M. Cargo, who stated that within a few days he would be able to operate two "shops," and that he could then turn out 10,000 incandescent lamps per day.

THE LOCAL ELECTRICAL FRATERNITY has suffered a sad bereavement through the deaths of two young men, Messrs. L. W. Robinson, Jr., and G. T. Fricke. The former had been connected with the Westinghouse Electric and Manufacturing Company since 1888. He was 24 years of age, and a son of Chief Engineer L. W. Robinson, U. S. N., so well known in connection with the Centennial Exposition and the Chicago World's Fair. Mr. Fricke was a son of the owner of the Penn Electric Works, of this city, and a young man with a very promising future.

WHILE SPEAKING to a reporter of the "Post," of this city, on the practicability of applying electricity as a motive power along country roads, Mr. George Westinghouse, Jr., is quoted as follows:

"The cheapening in the cost of equipment and in the maintenance of electric roads will tend to make their general use, both for freight and passenger carrying, much more extensive than has been the case. The value of electricity as a motive power is only beginning to be popularly recognized, and the progress being made from year to year is cheapening the cost of the apparatus, while simultaneously adding to its stability and effectiveness, will tend to a more general use for carrying purposes. I should think that electric roads through the farming districts, especially from their feature of forming a connection between the railroads and the portions of the country most remote from them, would assist in developing the country, and for this reason would meet with favor. The nearer a farmer gets to his market, the more he is inclined to branch out, and the cheaper he can convey his produce thither the more profitable becomes his business; besides that, he is abie to sell his goods at a lower price. But, of course, the establishment of electric roads is dependent not upon their availability or the extent to which they convenience the community, but upon their capacity to pay interest upon the money invested in them. It is easy to plan out a road aud exhibit its usefulness through the districts, but it is not always so easy to show that it will pay Speaking generally, I would say that electric roads will become more popular year by year. As time passes the builders of the appparatus will improve on present methods, and in time to come the system may be so far ahead of what it is to-day as that in vogue at present is advanced on the earlier efforts at transportation by electric power."

Mr. Westinghouse being asked whether he believed that electricity would displace steam power for long distances, replied that he did not think so.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, CHICAGO, Feb. 10 1894.

MR. F. B. BADT has severed his connection with the General Electric Company, and can be addressed, until further notice, care "Western Electrician," Room 6, Lakeside Building, or 6,506 Lafayette avenue, Chicago.

THE ELECTRIC APPLIANCE COMPANY, appreciating the demand which has existed for some time for a stock of high grade electric light carbons in Chicago, has made arrangements to carry a stock of the celebrated Crouse-Tremaine carbons sufficient to meet all reasonable demands for prompt shipments. It is also prepared to bid on large quantity orders for direct shipment from factory.

THE METROPOLITAN ELECTRIC COMPANY, general Western agents for "N. I. R." wire and cables, has recently had some very satisfactory tests from two of the largest buildings in Chicago in which its wire is used. The "N. I. R." factory has enlarged its line of products, and is now making electrolier wire, lamp cord, rubber and friction tape, as well as its regular wires and cables, which have so generally been regarded by the trade as first-class in every respect. A full stock of these goods will be carried by the Metropolitan Electric Company, at prices to suit the times.

News of the Week.

Electric Light and Power.

CISSNA PARK, ILL.—Cissna Park will have electric lights in the near future.

BROOKLYN, N. Y.—It has been decided to readvertise for bids for electric lighting.

GREENWOOD, S. C.—R. M. Freeman is in the market for an electric lighting plant.

PROSPECT, OHIO.—The electric light station at Prospect has been destroyed by fire.

CENTRALIA, KAN., residents are moving in the matter of an electric lighting plant.

GADSDEN, ALA.—The Etowah Ice and Cold Storage Company will buy a small dynamo.

TOPEKA, KAN.—Fire destroyed the boiler house of the Topeka electric light plant.

QUITMAN, GA.—The town of Quitman will soon issue bonds for an electric lighting plant.

PARIS, KY.—The Paris Electric Light Company is in the market for electrical machinery.

NEW BRITAIN, CONN.—The new Roman Cotholic church at New Britain is to be lighted by electricity.

DONALDSONVILLE, LA.—The City of Donaldsonville will soon receive bids for an electric lighting plant.

MERCHANTVILLE, N. J.—The Merchantville Electric Company is extending its electric lighting system.

MAHAFFEY, PA.—Residents of Mahaffey are moving strongly in the matter of a municipal electric lighting plant.

FAIRHAVEN, MASS.—Owing to poor light, J. K. Nye is trying to form a company to build an electric lighting plant.

CONFLUENCE, SOMERSET COUNTY, PA.—Residents are talking of an electric light plant for Confluence and Ursina.

HALLSTEAD, SUSQUEHANNA COUNTY, PA.—Hallstead and

Great Bend are talking of electric lighting for the streets.

GREENWOOD, MISS.—Marye & Wright will make the Board of Aldermen a proposition to put in twelve 1,200-candle power arc lights.

BROOKLYN, N. Y.—The property of the Edison Electric Light Company, at 358 Pearl street, Brooklyn, has been badly damaged by fire.

LYONS, IOWA.—The Council has instructed City Clerk Manville to purchase a new belt for the dynamo in the electric light building.

PORT JEFFERSON, L. I., N. Y.—The authorities of Port Jefferson are contemplating placing electric lights on the breakwater at the entrance of Port Jefferson.

RUSHVILLE, ILL.—Rushville will soon have a new electric light plant. Work is to be begun at once, and it will likely be completed and the plant be in operation within six months. J. Foote & Son will be the proprietors.

THE COLFAX ELECTRIC LIGHT AND POWER COMPANY, Colfax, Iowa, capital stock $25,000, has been formed to construct, maintain and operate electric light plants. L. H. Ong, J. Watland and P. Ratliff, New Sharon, Iowa, are interested.

OMAHA, NEB.—At a meeting of Council Comptroller Olsen was instructed to receive bids for furnishing the city with not less than 200 nor more than 300 arc street lights for the period of three years.

The Electric Railway.

KINGSTON, N. Y.—Residents are talking about building an electric road to Ellenville, but nothing has been done.

CHICAGO, ILL.—The Chicago City Railway Company is being urged to improve the Indiana street line.

ANDOVER, MASS.—The Selectmen of Andover have given a favorable hearing to the petition for the proposed South Side Street Railway Company.

WESTFIELD, MASS.—There is talk, but nothing definite has been done, in the matter of an electric road from the centre of the city to Woronoco Park.

CINCINNATI, OHIO.—The barns of the Cincinnati Street Railway Company, located at Avondale, a suburb of Cincinnati, have been burned. Loss over $180,000.

BOSTON, MASS.—Captain Joe V. Meigs is now before the House with an aplication for a franchise for a $10,000,000 company to build an elevated railway in Boston.

BOSTON, MASS.—William B. Mack and others have filed a petition with the Clerk of the House for a charter to build an elevated road in Boston and vicinity.

DOWNINGTOWN, PA.—The Borough Council of Downingtown has granted right of way to the Penn Traction Company for its proposed line from Philadelphia to Lancaster.

WORCESTER, MASS.—The directors of the North End Street Railway Company states that as soon as business revives it will surely extend the line from Worcester to Clinton.

GOSHEN, N. Y.—The Middletown-Goshen Traction Company has been granted a franchise to build an electric railway. Secretary Wightman of the company will give details.

PETERSBURG, VA.—Captain Thomas Hannill, of Petersburg, has asked for a franchise to build a street railway and operate it either by horse power or electricity. Action was deferred.

CHELSEA, MASS.—The West End Street Railway Company has petitioned for leave to establish and maintain a trolley line, and the petition has been refered to the committee on laying out streets.

EASTHAMPTON, MASS.—A motion has been carried to grant the Consolidated Road a franchise to extend from Northampton to Easthampton, with such restrictions as may be deemed advisable by the Selectmen.

AMSTERDAM, N. Y.—A bill has been introduced into the Legislature to authorize the Amsterdam Street Railway Company to supply light, heat and power to the residents and municipal authorities of Amsterdam.

BROCTON, CHAUTAUQUA COUNTY, N. Y.—The Brocton Street Railway Company has been incorporated with a capital of $10,000 and the following directors: Owen W. Powell, T. C. Moss and C. F. Rycjkman, of Brocton.

PROVIDENCE, R. I.—The Graham Equipment Company proposes to build a plant in Providence to build the Graham truck. C. S. A. Gardiner, of 1 Weybosset street, will give details. He is vice president and treasurer of the company.

TORONTO, ONT., CANADA.—The Toronto Railway Company has decided to strengthen the mechanical equipment at the power house by the addition of a new complete 6,000-h. p. outfit, which will include the engines, boilers, dynamos, etc.

PORTSMOUTH, N. H.—A party of capitalists, of Portland, Me., is in Portsmouth trying to buy up the charter of the Portsmouth Horse Railroad Company. This, it is stated, is part of a scheme for an electric road from Portland to Boston.

Personal Notes.

MR. GEORGE M. PHELPS, president of the "Electrical Engineer," has the sympathy of the entire electrical fraternity in his sad affliction in the loss of his wife, whose death occurred in Brooklyn on Saturday, Feb. 10. The charming personal qualities of Mrs. Phelps had endeared her to a large circle of friends in an unusual degree.

DR. COLEMAN SELLERS has been so prominently identified with the scheme for the utilization of Niagara Falls for power purposes, almost from its inception, that his name is almost invariably associated with it. Dr. Sellers' training throughout his long career has been along lines which would best fit him for work of such a magnitude as this. Born in Philadelphia in 1826, he received his early education in private schools there, and later attended a boarding school at West Chester, Pa. At the age of sixteen he was apprenticed to a farmer, but after spending three years at this work, went to Cincinnati, Ohio, where he joined his brothers in the Globe Rolling Mills. After three or four years there, he entered the Niles Locomotive Works, where he remained until 1856, when he returned to Philadelphia as engineer for William Sellers & Co. He continued there as engineer and as member of the firm until the incorporation of the present company, and then with the new firm until obliged to resign on account of ill-health, in 1888. He then carried on an independent business as consulting engineer, and later became associated with the Cataract Construction Company. He was one of the five members of the International Commission, and is president of the Niagara Falls Power Company. He is past president of the American Society of Mechanical Engineers, member of the British Institution of Civil Engineers, professor of applied science at Steven's Institute and of mechanics at the Franklin Institute, etc.

MR. CLEMENS HERSCHELL, who, as hydraulic engineer for the Cataract Construction Company has been largely responsible for the success of that great undertaking, was well equipped for the work. He was graduated from the Lawrence Scientific School, Harvard University, in 1860, and completed his technical education in the scientific school at Carlsruhe, Germany. After spending three years in this school, on his return to the United States he immediately began the practice of his profession, which he continued for fifteen years at Boston. During the last two years of this period he was connected with the main drainage works. Then he went to Holyoke, Mass., as hydraulic engineer for the Holyoke Water Company, where he remained for ten years. He then connected himself with the New Jersey Water Company, a position which he held until he became interested in the work at Niagara. Mr. Herschell is a member and ex-director of the American Society of Civil Engineers and also a member of the British Institution of Civil Engineers. The consummation of this great piece of engineering work in the successful starting of the mills of the Niagara Falls Paper Company a few days ago reflects great credit upon Mr. Herschell and sustains his reputation as one of the foremost hydraulic engineers of the world.

Miscellaneous Notes.

THE NEW ORLEANS ELECTRIC CLUB held its regular meeting at its new room on Friday, Feb. 2. Mr. Warren B. Reed, of the Edison Illuminating Company, read an interesting paper on "Chemical Meters." Prof. Brown Ayres entertained those present with a working diagram showing the action of alternating currents.

A TROLLEY WIRE DECISION.—The Louisiana Court of Appeals has affirmed a judgment against the city of Shreveport and the City Railway Company, of the same place, for the value of a horse killed by a fire alarm wire in contact with a trolley wire. The court held that both appellants were guilty, the former for not insulating the fire alarm wire, and the latter for not having guard wires.

A LEADING TRADE PAPER.—"The Jewelers' Circular" celebrates its silver anniversary by the issue of a 142-page number, with a handsomely designed and silvered cover. An interesting sketch is given of the history of the various firms that advertised in the first number, and other features are sketches of prominent houses in the jewelry trade and a collection of bright trade notes and commercial sketches by the various correspondents of the "Circular." There are also a number of special articles dealing with various phases of the jewelry trade, a novelette with a pearl necklace as the theme, and a volume of advertising that shows that the high merits of this class journal are appreciated by those in whose interest it is published.

AN ELECTRIC HEATING PATENT.—The Carpenter Enamel Rheostat Company, as the assignee of C. E. Carpenter, has recently had issued to it a patent which, it claims, controls broadly all commercial forms of enamel rheostats and heaters. The patent is No. 511,407 of Dec. 26, 1893. A sample claim reads as follows: Claim I.—"The improvement in the method of constructing resistances, which consists in attaching to a suitable support a coating of enamel by fusing the same; placing upon the surface of the coating an electrical conductor, covering said conductor with a coating of enamel having fusing point lower than the enamel already applied, and raising the whole to a temperature sufficient to fuse said second layer of enamel, substantially as described."

Trade and Industrial Notes

McDOUGALL, LUCAS & CO., manufacturers' agents for central station specialties, The Rookery, Chicago, are successors to the firm of McDougall & Cummings, of the same city.

W. C. STERLING, Monroe, Mich., the well known dealer in cedar telegraph poles, admitted his son, Will C. Sterling, Jr., to partnership on Feb. 1, and the name of the firm will hereafter be W. C. Sterling & Son.

THE JOHN T. NOYE MANUFACTURING COMPANY, Buffalo, N. Y., is no longer represented in the West by Fairbanks, Morse & Co., and all business will be transacted through the main office in Buffalo until a new Western agent is appointed.

THE LUNKENHEIMER COMPANY, Cincinnati, Ohio, has issued an illustrated price list of the "Lunken" renewable seat gate valve, which gives a comparison of its advantages in simplicity, strength and compactness over the old-style valve.

ELLIOTT BROS., 101 St. Martin's Lane, London, England, have issued a prospectus devoted to Ayrton & Mather's new electrostatic reflecting and gravity voltmeters, containing descriptions and other information relating to these instruments.

MR. GEO. E. PRATT has resigned his position as contracting agent of the Lamokin Car Works of Philadelphia, where he had been employed four years, and accepted a position with the Jackson & Sharpe Company, of Wilmington, Del., representing them in their street car department.

N. S. LARGE & SON, 321 Chestnut street, Philadelphia, has issued an illustrated price list, No. 1, of single and double and three-pole knife switches and main fuse blocks. This firm also manufactures general electrical supplies, and special attention is given to model, repair and experimental work.

THE TAYLOR ELECTRIC TRUCK COMPANY, Troy, N. Y., has issued a catalogue devoted to its improved electric steel truck. That the company includes the Messrs. Gurley, the world-known instruments makers, is in itself evidence that the claims made for the superior merits of the truck rest on a firm basis of fact.

THE WROUGHT IRON BRIDGE COMPANY, Canton, Ohio, has secured a contract for the erection of a steel bridge for the Pittsburg, Coraopolis and Neville Island Electric Railroad Company. The bridge will be 1,086 feet long, having three spans and five piers, and will cost about $60,000. Work is expected to commence about March 1 next.

JONES BROS.' ELECTRIC COMPANY, of Cincinnati, Ohio, is about to bring out a new lightning arrester, which, it claims, will be much the simplest arrester on the market, and can be sold at very reasonable prices. It will be made in three designs, one for station work, another for outside work and a third for use on electric street cars.

MR. J. POTTER, so long and so prominently identified with the Brush Electric Company in Cleveland, has associated himself in an executive capacity with the Buckeye Electric Company. The recent decision in favor of the Buckeye Company seems to be bringing it lots of business. Messrs. Prentiss, Rockwell and Potter, however, will provide facilities for handling all the business that comes to the company.

WARREN & BURHORN, 136 LIBERTY STREET, NEW YORK, have been appointed as consulting engineers to draw up plans and specifications for a complete isolated electric light plant, to be installed in the Trenton asylum for the insane, which, with others, is under the control of the State Board of Managers of Asylums. The plant will include engine, possibly direct connected, and wiring complete for about 1,000 lights.

WILLIAM HAZLETON, 3rd., Havemeyer Building, New York, has been made the general Eastern agent of the Fulton Truck and Foundry Company, of Cleveland, Ohio, which manufactures steam and street railway specialties. Its goods have been very thoroughly introduced in the West and it has just completed a new factory in Mansfield. It manufactures a complete line of electric, steam and street railway supplies.

THE E. P. GLEASON MANUFACTURING COMPANY, 189 Mercer street, New York, has recently published a new folder describing and illustrating some of its specialties in silvered porcelain reflectors for electric lighting. Its newest reflector is a cluster of 4, 5, 6 or 8 incandescent lights with a porcelain shade above which is covered on one side with quicksilver, which makes a very ornamental fixture. It is constantly increasing its line of cut glass shades and globes for electric fixtures and has an immense line of brass goods and fancy colored globes.

CHARLES RETTIE, 18 Geraint street, Liverpool, England, sends us a handsome calendar containing a number of colored views of applications of electricity. Among the views is one of a large Atlantic liner, labelled "The Ship of the Future, Driven by Electricity—Across the Atlantic in Three Days—30,000 B. H. P." Assuming that "B. H. P" means battery horse power, and that a storage battery may be invented that will develop an hourly horse-power on a weight as low as 50 pounds, to develop the power referred to will require 54,000 tons of storage battery.

THE MASON REGULATOR COMPANY, 10 Central street, Boston, Mass., has added a new volume to its admirable series of practical manuals, the title of the present one being "What An Engineer Should Know About Electricity." (50 cents.) The same company has in preparation a "Chief Engineer's Record Book and Engineer's Log," and has published the following works for the engineer: "Key to Engineering" (30 cents); "Common Sense in Making and Using Steam" (25 cents); "The Engineer's Epitome" (50 cents); "Key to Engineering" (50 cents); "Engineer's Catechism" (25 cents).

M. T. DAVIDSON, 43 to 53 Keap street, Brooklyn, N. Y., finds business extremely good, particularly with the Davidson Independent Air Pump and Jet Condenser, which is now in use in many prominent electric street railway and power stations, notably the Ishpeming Street Railway Company, Ishpeming, Mich.; Wilmington Street Railway Company, Wilmington, N. C.; Utica Street Railway Company, Utica, N. Y.; Toronto Street Railway Company, Toronto, Can.; the Akron Electric Light Company, Akron, Ohio; Erie Electric Light Company, Erie, Pa., and Oshkosh Electric Light Company, Oshkosh, Mich. This apparatus has given very satisfactory results in every case where it has been adopted.

THE PURITY OIL FILTER MANUFACTURING COMPANY, 90 Water street, Pittsburg, Pa., in one day, recently, shipped the following orders: Port Deposit (Md.) Electric Light Company, Market Street Electric Railway Company (third order), San Francisco, Cal., and Oakland, Cal., Gaslight and Heat companies and Ella Coal Company, Milesville, Pa. The following letter from the superintendent of the San Francisco Edison Light and Power Company is a sample of many received: "The Ideal Oil Refiner has proved satisfactory in every respect. I have tried several oil filters and prefer the Ideal to any of them. The oil comes out clear and cool, and cannot be distinguished from new oil."

WARREN WEBSTER & CO., Camden, N. J., has published an account of the tests of the Webster steam and oil separators made at the World's Columbian Exposition by George H. Barrus. The conclusions are that the steam separator in handling 17½ per cent. of the moisture intercepted the whole quantity. In the test of the oil separator it was found that 86.7 per cent. of the oil was accounted for. The balance, namely 13.3 per cent., covers that which disappeared in the process of lubricating the cylinders and working parts, that which clung to the sides of the pipes and the sides and plates in the separator, and that which passed on with the steam and collected in the water of condensation. There was a slight trace of oil on the surface of the water drawn from the condenser, which appeared in the shape of an exceedingly thin film, barely perceptible.

THE AUTOMATIC TELEPHONE AND ELECTRIC COMPANY, 35 Wall street, New York, sole licensee of the Strowger automatic switch for New York, whose primary object is to establish telephone systems throughout the State, calls attention in a circular to the benefit of its system. Among the advantages mentioned are: Immediate connection with the number desired or person with whom you wish to converse; entire absence of the frequent tedious delays occasioned by indifference of operators or inability to handle business promptly as desired and the equally frequent and unsatisfactory response to calls "They are busy!"; absolute secrecy of conversation when desired, at times so essential to business men as well as in private life; continuous service both day and night, rendered impracticable in many towns under the present system by reason of the necessary additional expense involved in the employment of night operators; economy in operating, insuring the subscribers lower rentals than can be possibly obtained under any other systems, bringing its use within the reach of thousands heretofore unable or unwilling to pay the rental demanded; perfect adaptability to the smallest towns and villages as well as to cities; impossibility of interruption or disconnection during conversation; disconnection automatically when through talking.

THE AMERICAN SILK MANUFACTURING COMPANY, 311 Walnut street, Philadelphia, manufacturers of silk wipers especially adapted for wiping dynamos and all fine parts of electrical machinery, is very much gratified with the large increase of orders for its wipers during the month of January, which were 100 per cent. larger than those of the previous three months, notwithstanding the fact that January is usually a very dull month in this line. A portion of this increase may be due, in a measure, to the fact that this company is now furnishing a new and improved compound for washing these wipers, which is very much superior to the compound furnished heretofore. The new compound is not affected by heat or air, and will in no manner injure the fibre, and is furnished free of charge. The American Oil Company, of San Francisco, upon application, has recently been appointed sole agent for the Pacific coast, and has already sent in a large order. One of the leading cotton waste dealers in Pittsburg, Pa., has also sent in a nice order. The greater portion of the orders come from electrical firms.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., is again actively in the field for business, having been entirely reorganized, and being now under the control of a syndicate of practical Connecticut capitalists, among them being M. S. Chapman, its president, who is also president of the Waring Electric Company and Perkins Lamp Company, and in charge of the government envelope works at Hartford, Conn.; Henry A. Redfield, president of the Phoenix National Bank of Hartford; Charles E. Perkins, the well-known patent lawyer of Hartford; who has been permanently identified with all the recent lamp litigations; T. C. Perkins, son of Charles E. Perkins, who is vice president of the company, and who is well known to the electrical fraternity through his connection with the Ball & Wood Engine Company; C. M. Jarvis, president of the Berlin Iron Bridge Company, who needs no introduction; John L. Bunce, secretary and treasurer of the company, formerly connected with the Schuyler Electric Company and Perkins Lamp Company, and Norman McD. Crawford, electrician of the Hartford Street Railway Company, originally from Philadelphia, where he obtained prominence as an electric railway engineer through his connection with the Philadelphia Traction Company in an advisory capacity. Under the reorganization the company introduces itself free from debt and with ample working capital. Its general selling agency in Boston is discontinued, as is also its agency representation anywhere, with the belief that it is in the line of wisdom and economy to sell direct to customers, or through contractors of undoubted reliability and financial standing. All its business hereafter will be transacted at Manchester, Conn., and efforts will be directed particularly to the construction of large dynamos and generators for electric lighting plants, electric railways and railway equipment, for which its factory is admirably adapted; its new erecting shop, 200x50 feet, being especially designed and constructed by the Berlin Iron Bridge Company, with its electric traveling crane for the expeditious handling of large apparatus. The Mather system of incandescent lighting and transmission of power is too well known to require special mention, and it is sufficient to say that the high standard of its manufacture in the past will be sustained in every respect in the future, and with such a prominent organization it would appear that success must attend it. Vice President Perkins and Secretary-Treasurer Bunce are both young men of ability and energy, and should earn for themselves enviable reputations.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED JAN. 30, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

11,400. Reissue. SYSTEM OF ELECTRICAL DISTRIBUTION; W. Stanley, Jr., and J. F. Kelly, Pittsfield, Mass. Application filed Nov. 29, 1893. This comprises primary coils connected in series with the source of electricity, secondary coils forming the source of current for local working circuits and condensers in series with the secondaries, and adjusted to neutralize the electromotive force of self-induction in the secondary circuits.

513,482. ANTI-INDUCTIVE CONDUCTOR; Horace F. Chick, Watertown, Mass. Application filed May 29, 1893. The combination with a metallic circuit composed of two branches or wires of a separator of textile material, wound about and between the branches or wires throughout the length of the circuit to separate and yet bind them, and which separator is attached to one of the wires at the points where it crosses or intersects the same.

513,498. TRAIN-OPERATED DEVICE; Johann Heinrich Frischen and Robert Pfeil, Berlin, Germany. Application filed Nov. 28, 1893. In an electrical train-operated mechanism, a pair of track instruments; circuit-making devices connected therewith; and electrically actuated signal device controlled by one of said circuit-makers; and means controlled by the opposite track instrument for closing the circuit through the circuit-maker to the signal device.

513,526. FIRE ALARM TELEGRAPH SYSTEM; Michael J. O'Sullivan, Baltimore, Md. Application filed June 7, 1893. In a device of the class described, the combination of the main line circuit wire, connected to the circuit-breaking wheel, a sliding contact bar adapted to alternately make and break contact with the circuit-breaking wheel when the wheel is turned; the main line circuit wire, attached to the contact bar; a stationary guide piece for the sliding contact bar and having contact points; insulation between the sliding contact bar and the guide piece; a ground wire in electrical connection with contact points; an electric bell in the line of the ground wire; and contact points on the sliding contact bar normally separated from, but adapted to contact with the contact points on the guide piece, and thus cut in the ground wire, when the main line circuit is broken by turning the contact-breaking wheel.

513,534. SIGNALING SYSTEM FOR TELEPHONE CIRCUITS; John I. Sabin and William Hampton, San Francisco, Cal. Application filed Aug. 18, 1893. Individual calling indicators on a local battery circuit, in combination with subscribers' metallic circuits, each composed of two line wires, connected to opposite sides of the said local circuit at the switchboard to form part of the local circuit, and means for uniting the two line wires at the subscriber's telephone to close the battery upon the said indicators.

513,537. SIGNALING SYSTEM FOR TELEPHONE TRUNK LINES; Charles E. Scribner, Chicago, Ill. Application filed June 16, 1893. The combination with a trunk line of a signaling circuit extending between the terminal stations thereof and normally including a signal indicator at each of said stations, a local branch circuit at one of said stations, including a source of electric current, and a key at that station adapted to connect the corresponding signal indicator alternately into the signaling circuit and the local circuit.

513,545. CIRCUIT CONTROLLER FOR REGULATORS; B. B. Ward, New York, N. Y. Application filed May 10, 1893. The combination with an expanding and contracting member of a fixed contact, and a retarding device controlling the movable contact.

513,564. ELECTRIC WIRE CLEAT FOR HOLDER; A. W. Fuller, Saugus, Mass. Application filed March 13, 1893. This consists of a many sided block having two parallel grooves formed upon two or more of its sides.

513,566. TROLLEY WIRE FINDER; E. Gale, Peoria, Ill. Application filed Nov. 21, 1892. The combination of the trolley pole and wheel with a revoluble guard extending laterally beyond the vertical planes of the sides of the wheel.

513,587. ELECTRO-MECHANICAL DEVICE FOR BELLS; W. O. Meissner, Chicago, Ill. Application filed Sept. 11, 1893. The combination with a spool magnet and projecting pole pieces of an armature pivotally supported on both poles at one side of the spool and adapted to be moved to and from the pole pieces toward the other side of the spool.

513,592. ANNUNCIATOR; J. H. McEvoy, Waterbury, Conn. Application filed May 8, 1893. This comprises a spool magnet, having its armature supported beneath the core, and having upwardly projecting parts at one side of the core and adapted to embrace the ends thereof, so that two armatures lie on one side of a vertical plane passing through their support.

513,593. ELECTRIC BELL; J. H. McEvoy, Waterbury, Conn. Application filed May 8, 1893. This comprises a bell having an arm carrying a rigid notched piece to engage and secure one end of the box or cover of the bell.

513,601. MECHANISM FOR CONTROLLING ENGINES; Benjamin Frank Teal, Chicago, Ill. Application filed Aug. 14, 1893. An apparatus of the character described, comprising a cylinder, the escape port of which is provided with a controlling valve, a position within cylinder provided with an operating rod, an electromagnet for shifting escape port valve, and an adjustable connection between the armature of magnet and escape port valve, whereby the shift can be regulated.

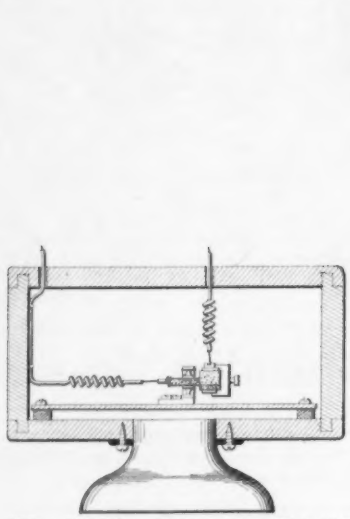
513,611. DYNAMO BRUSH; Wilfred H. Fleming, Bayonne, N. J. Application filed Nov. 13, 1893. A dynamo brush, consisting of successive layers of wire gauze to the length of the brush, compacted together by pressure.

513,612. ELECTRICAL REGISTERING DEVICE; Frederich Von Hefner-Alteneck, Berlin, Germany. Application filed Nov. 3, 1893. In an electrical recording apparatus, the combination of a generator, an electric circuit therefrom; a recording tool in said circuit and normally operated by generator; a tape adapted to be punctured by recording tool; a feed device carrying said tape

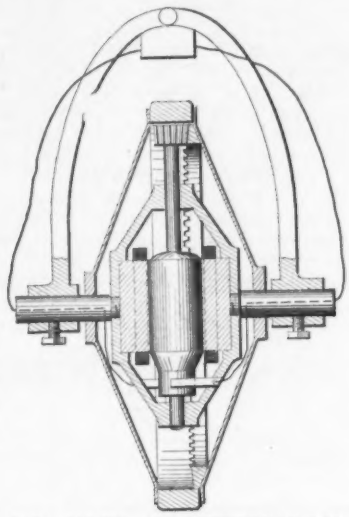
and normally out of circuit; and a switch adapted to contact with said feed device and automatically short-circuit the recording tool there through upon the giving out or breaking of said tape, substantially as described.

513,626. AUTOMATIC RHEOSTAT; C. J. Sturgeon, Erie, Pa. Application filed March 31, 1893. This comprises a rheostat acting automatically to cut out its own resistance coils until the full volume of the current flows into the motor or other apparatus in circuit therewith.

513,630. DETACHABLE ELECTRIC WIRE HOLDING DEVICE; C. Beard, Brookline, Mass. Application filed Oct. 20, 1893. This



NO. 513,730.—TELEPHONE TRANSMITTER.



NO. 513,859.—ELECTRICALLY PROPELLED DRIVE WHEEL.

consists of a looplike clip adapted to embrace the support and provided with a wireholding eye, through which a wire is passed and thereby secured to the fixture.

513,720. TELEPHONE; Herbert S. Page, Somerville, Mass. Application filed May 15, 1893. In a microphonic telephone transmitter, the combination of a diaphragm of glass, or other insulating material, the outer surface of which is carbonized and the inner surface of which is platinized; of two electrodes in contact suspended by suitable conducting supports, one of the electrodes being in contact with platinized surface, all included in a battery circuit.

513,725. ELECTRIC ARC LAMP; F. A. Perret, Brooklyn, N. Y. Application filed Nov. 7, 1892. This comprises a pivoted frame carrying a train of gear engaging with the carbon rod, a rotary armature in the form of a disc or star controlling the train and a solenoid having its core connected with the frame and also extending into attractive distance of the rotary armature.

513,729. TELEPHONE TRANSMITTER; Francis H. Richards, Hartford, Conn. Application filed Dec. 4, 1893. In a telephone instrument, the combination of two electrodes adapted and in position for sliding contact, the one upon the other, and one of them having a compound working face comprising relatively electrical and non-electrical fields, and means for operating one electrode relatively to the other.

513,730. TELEPHONE TRANSMITTER; Francis H. Richards, Hartford, Conn. Application filed July 31, 1893. In a telephone transmitter, the combination with a plate sensitive to sound waves and with the compound electrode operatively connected therewith and having a working face comprising an electrical and non-electrical field, of the opposite electrode bearing against said working face and having a supporting pivot, and an electrode carrier supporting electrode by its pivot to bear against working face. (See illustration.)

513,745. SWITCH-BAR; Franklin A. Weller, Boston, Mass. Application filed Feb. 27, 1893. In a motor switch, the combination with the stationary contacts of the switch-bar, the movable and extensible contact arm carried thereby, a latch for holding said arm and an operating handle.

513,775. ANNUNCIATOR; Manious Garl, Akron, Ohio. Application filed June 28, 1893. The combination of the magnet provided with flanges, the collar, the indicator shaft provided with an indicator, an armature provided with arms extending below the magnet, the extended wire located below the magnet, the arm and hooked arm, the gravity arm provided with the curved slot and the rib.

513,777. ELECTRIC CONNECTION FOR RAILWAY RAILS; Alfred Green, Rochester, N. Y. Aplication filed Sept. 30, 1893. The combination with the rails of an electric railway of the conductor wire and wire connections, provided with stems and slots, said wire being removably fixed in the slots and the wire extending and supported beyond the ends of one or more rails in each direction, whereby, when the wire is unfastened, as by unsoldering, the rails may be removed without interrupting the current.

513,796. AUTOMATIC CIRCUIT-CLOSER; Henry Lewers, Carson City, Nev. Application filed July 11, 1893. In an automatic circuit-closer for fire alarm circuits, the combination of an inclosing tube permanently stopped at one end, a spring placed in the tube and abutting against the closed end of the tube, a perforated stopper provided with two contact pieces, a circuit-closing pin inserted in the perforation of the stopper and resting on the spring, and means for holding the circuit-closing pin out of contact with the contact pieces.

513,829. ELECTRIC ALARM; David S. Schureman, Rockford, Ill. Application filed May 6, 1893. A thermometer having a dial of conducting material, and insulated bushings extending through and attached to the face of the dial.

513,839. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles H. Talmage, St. Louis, Mo. Application filed March 31, 1893. The combination with a solenoid plunger having a ratchet-toothed stem and a ratchet wheel operating therewith, of a detent pawl for the ratchet wheel, and an adjustable trip carried by the plunger stem to disengage said pawl, and adjunctive devices operating therewith.

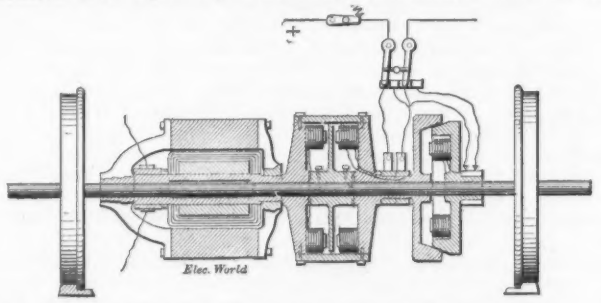
513,846. TROLLEY POLE STAND; Gustaf Valley, Cleveland, Ohio. Application filed May 6, 1893. In a trolley pole stand in combination, a trolley pole plate bearing a socket for engaging the trolley pole, such socket being tapering externally, and having a split free end with a compression band engaging the same, such trolley pole plate being suspended by links, a semi-elliptic spring and cross-head for holding the link taut.

513,847. TROLLEY POLE STAND; Gustaf Valley, Cleveland, Ohio. Application filed May 11, 1893. In combination a base plate for attaching to the car top, a trolley pole plate bearing a socket for engaging the trolley pole, such trolley pole plate being suspended by means of links, the links from the one side thereof engaging hooks or opposing members of the base plate, the links from the other side of the trolley pole plate engaging a cross-head, a coiled spring connected with and acting on the cross-head in the direction to hold the links taut.

513,859. ELECTRICALLY PROPELLED DRIVEWHEEL; Carl G. Anderson, Lynn, Mass. Application filed Sept. 1, 1892. In an electric driving wheel, the combination with the shafts upon which said wheel is loosely mounted of a stationary electric motor arranged within the wheel and secured to the shafts, and intermediate gearing connecting the motor and wheel whereby a rotary motion is imparted to the latter. (See illustration.)

513,894. SECTIONAL ELECTRIC RAILWAY; George W. Demmick, Lynn, Mass. Application filed July 20, 1893. In combination, shelves and diaphragm and the rods provided with the convex flanges or guards.

513,895. POWER-TRANSMITTING MECHANISM FOR ELECTRIC LOCOMOTIVES; Mark W. Dewey, Syracuse, N. Y. Application filed April 17, 1891. The combination with an electric



NO. 513,895.—POWER TRANSMITTING MECHANISM FOR ELECTRIC LOCOMOTIVES.

motor and a shaft or wheel to be driven, of an electric speed reducing mechanism connected to the moving part of the motor and to the shaft or wheel, and consisting of two parts in close proximity to and adapted to electrically attract or repel each other, and a conical friction clutch mechanism connected to the moving part of the motor and the shaft or wheel. (See illustration.)

513,921. ELECTRIC-ARC LAMP; Manuel Rafael Gutierrez and Milton T. Thompson, Jalapa, Mexico. Application filed Aug. 8, 1893. In an arc lamp, the combination with a cross-bar of insulating material, carbons pivotally connected with the cross-bar, levers connected with the pivoted ends of the carbons for moving the carbons simultaneously in opposite directions, and feeding mechanism connected with the cross-bar for lowering the carbons and turning them on their pivots.

513,948. AUTOMATIC DAMPER REGULATOR; H. F. Maxim, Norfolk, Va. Application filed March 14, 1893. This comprises a motor having a crank arm extending on each side of its axis and actuating the shifting lever, a thermostat, a magnet connected therewith, spring supported armature for the magnet, having a slot adapted to receive the ends of the crank arm alternately and a spring partly filling the slot and engaging the ends to prevent their recoil.

513,949. CONNECTOR FOR ELECTRIC WIRES; E. H. Munson, New Britain, Conn. Application filed May 9, 1892. This comprises a shell adapted to be secured to one end of one wire, a plug secured to the other end of the other wire and adapted to fit closely within the open end of the shell and having a soft packing for sealing the open end, the ends of the two wires being electrically connected within the shell.

513,950. INSULATED RAIL CHAIR; L. McCarthy, Boston, Mass.

Application filed Sept. 27, 1892. The combination with an insulated rail chair of cheek-pieces extended laterally and provided with a skirt or overhang.

513,951. INCANDESCENT LAMP SOCKET; James McFarlane and William Burgess Edgar, Glasgow, Scotland. Application filed March 31, 1893. In a switch for incandescent electric lamp sockets, the combination of the insulated base formed with the openings, the key and piston fitting in said openings, the bent contact spring carried by said piston and the spiral spring surrounding said contact spring, substantially as shown and described.

513,956. ANNUNCIATOR; F. W. Ross, Boston, Mass. Application filed Oct. 6, 1893. This comprises a single helix having a sliding armature core and mounted vertically upon a face-plate; an unequally balanced lever carried upon a spindle and having a rachet adapting it to be tripped by the core; a sleeve attached to the face-plate and a spindle within the same, one end carrying the lever and an index finger carried upon the opposite end of the spindle.

513,960. AUTOMATIC TELEPHONE SWITCH; A. C. Wheat, Chicago, Ill. Application filed June 5, 1893. This comprises a pivoted lever having compartment receptacles, insulated end pieces, terminals, and a conducting substance placed within the compartments and adapted to be shifted therein.

U. S. PATENTS ISSUED FEB. 6, 1894.

513,975. INDUCTIVE MECHANISM FOR ELECTROSTATIC INSTRUMENTS; W. E. Ayrton and T. Mather, London, England. Application filed May 1, 1893. The combination of a skeleton needle and curved fixed sheet inductors, embracing both faces of the needle peripheries.

513,982. ELECTRIC CONDUCTOR; H. F. Chick, Watertown, Mass. Application filed May 1, 1893. This consists of one or more insulated conducting strands or wire, a braided fibrous jacket enveloping the same, and a braided wire protecting jacket.

514,018. CUT-OUT BLOCK; E. J. McEvoy, New York, N. Y. Application filed July 29, 1893. This comprises a block adapted to receive the main wires, contact plates mounted on the block, hooks adapted to engage projections on the plates, a cap block and cap wire terminals mounted in the cap block.

514,019. CIRCUIT CONTROLLER; E. J. McEvoy, New York, N. Y. Application filed Aug. 31, 1893. This consists of a rotatable shaft, mounted in a box and adapted to close and open a circuit when a door is opened or closed.

514,030. LOAD GOVERNOR FOR ELECTRIC CURRENTS; F. E. Pritchard, Oswego, N. Y. Application filed Nov. 19, 1891. This consists of a resistance coil adapted to be connected with the conductors as the load is decreased.

514,047. DYNAMO AND MOTOR; M. Waddell, Bridgeport, Conn. Application filed March 13, 1893. This comprises two conducting rings insulated from each other, commutator brushes carried by the rings, and a spider for supporting the rings.

514,056. CONDUIT ELECTRIC RAILWAY; R. C. Beardsley, Lafayette, Ind. Application filed Jan. 28, 1893. The combination of a slotted conduit and switch boxes arranged alongside the same, switches in the boxes, movable parts of which project into the conduit, and removable covers for the boxes, upon which a portion of the switches is mounted.

514,057. HOOD FOR ELECTRIC ARC LAMPS; S. Bergmann, New York, N. Y. Application filed Jan. 10, 1893. A hood having its upper part provided with a depending flange and its lower part arranged to fit into the same, the two parts being held together by screws.

514,058. ELECTRIC ARC LIGHT FIXTURE; S. Bergmann, New York, N. Y. Application filed Jan. 10, 1893. A removable lower carbon holder provided with an ash pan or dust receptacle.

514,075. ELECTRICAL MEASURING OR INDICATING INSTRUMENT; S. E. Hitt, Rockford, Ill. Application filed April 7, 1893. A measuring instrument arranged with a spherical magnetic shield entirely surrounding the same.

514,077. ELECTRIC MOTOR; J. D. Ihlder, Yonkers, N. Y. Application filed Sept. 29, 1893. A compound wound motor having a shunt field magnet coil connected to the terminals of the supply circuit, a series field magnet included in the armature circuit and a resistance arranged in parallel with the series field magnet circuits.

514,078. ELECTRIC ELEVATOR MOTOR; J. D. Ihlder, Yonkers, N. Y. Application filed Sept. 29, 1893. A compound wound motor having means for reversing the current in a portion of a series field magnet coil in one or more sections included in the armature circuit.

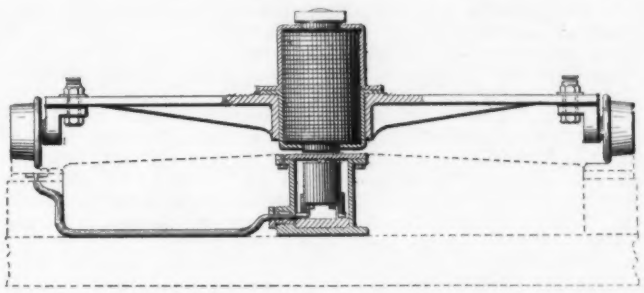
514,083. DEVICE FOR PREVENTING RAILWAY COLLISIONS; G. F. Klaffky and F. Faltinowsky, New York, N. Y. Application filed Nov. 3, 1893. This comprises a disc fixed on the throttle valve to turn therewith, a mutilated worm wheel on the valve stem and a motor adapted to operate the same.

514,109. ELECTRIC CAR TRUCK; C. F. Winkler, Kingston, N. Y. Application filed May 22, 1893. The combination of a motor having two armatures and a single field magnet, two axles geared respectively to the armatures and a flexible connection between each armature and its corresponding axle.

514,112. CLOSED CONDUIT ELECTRIC RAILWAY; F. M. Ashley, Hawthorne, N. J. Application filed Dec. 23, 1892. The combination of two abutting ends of rails, the ends being provided with openings leading to a drain.

514,113. ELECTRIC RAILWAY; F. M. Ashley, Hawthorne, N. J. Application filed Dec. 23, 1892. The combination of two sections of a trolley wire and a hanger located at a joint between them, the hanger consisting of plates, insulating block, collar and hook.

514,114. ELECTRIC RAILWAY CONDUIT; F. M. Ashley, Hawthorne, N. J. Application filed Dec. 23, 1893. This comprises a conduit divided into two compartments in the same horizontal



NO. 514,112.—CLOSED CONDUIT ELECTRIC RAILWAY.

plane, one closed and the other open, a traveling switch moving in the former, and rails located above and below the switch upon which it runs, one of the rails being sectional, and a sectional conductor located in the open compartment.

514,115. ELECTRIC BATTERY; F. Bayer, New York, N. Y. Application filed Aug. 24, 1893. In a positive electrode the combination of a central insulated rod and insulated cup containing mercury on its lower end and blocks of zinc strung on the rod, the lower block lying in the mercury.

514,120. ELECTRIC RAILWAY; O. A. Enholm, New York, N. Y. Application filed Oct. 3, 1892. This comprises a conduit divided into a closed and an open compartment, a circuit controller running in the sealed compartment, a collector running in the open compartment and electromagnetic apparatus carried with the collector and controlling the movements of the circuit controller.

514,128. SIGNALING SYSTEM; J. G. Noyes and L. Winterhalder, Milford, Conn. Application filed July 3, 1893. This comprises a want wheel and a locality wheel, each manipulating a separate circuit to a central station, and a cut-out device controlled by the movement of the want wheel operating to cut out the locality wheel until the want wheel has sent in its signal.

514,131. ELECTRIC METER; C. Raab, Kaise, Slautern, Germany. Application filed Jan. 21, 1893. A motor meter having an armature lying in shunt, and consisting of solenoids, solenoids comprising the magnetic field, and a damping disc.

514,133. UNDERGROUND ELECTRIC CONDUCTOR; H. A. Seymour, Washington, D. C. Application filed Aug. 30, 1890. This consists in inclosing the main conductor in a yielding envelope of insulating material and providing the lower portion of the envelope with conducting devices adapted to be forced into contact with the main conductor by the pressure of a trolley wheel against it.

514,134. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; H. A Seymour, Washington, D. C. Application filed Aug. 29, 1892. This comprises a conductor secured to the under side of an inverted shell, a flexible water-tight diaphragm secured to the under side of the shell and electric conducting contacts attached to the diaphragm.

514,136. MOTOR CONTROLLING DEVICE FOR ELECTRIC LOCOMOTIVES; S. H. Short, Cleveland, Ohio. Application filed Jan. 6, 1890. This comprises two operating shafts and switches connected therewith for reversing the motion or rotation of the motor and varying its speed.

514,139. ELECTRIC ARC LAMP; G. G. Wagner, New York, N. Y. Application filed Nov. 15, 1892. This comprises a fixed carbon holder attached to a vertical shaft connected to a train of gearing, and a single solenoid coil extending through two solenoid coils, one of which is in circuit with the carbons and the other in shunt circuit.

514,140. ALTERNATING DYNAMO; J. J. Wood, Fort Wayne, Ind. Application filed June 20, 1893. The combination with the field magnet poles and coils of a pair of U-shaped plates fastened against the front and back of the poles, with their legs extending along the sides thereof to support the coils.

514,146. ORGAN; R. Hope-Jones, Birkenhead, England. Application filed Aug. 8, 1892. The combination with the electrical connections of a keyboard of a compound switchboard, whereby the connections with the keyboard can be changed one or more half notes.

514,150. COMMUTATOR BRUSH; J. F. Kester, Buffalo, N. Y. Application filed Nov. 23, 1893. A lubricator leaf for commutator brushes provided with interstices filled with a lubricating material composed prnicipally of beeswax.

514,167. ELECTRICAL CONDUCTOR; N. Tesla, New York, N. Y. Application filed Jan. 2, 1892. A conductor composed of a wire for carrying the current, an insulated coating or covering and a surrounding conducting sheath or screen divided into insulated sections.

514,168. MEANS FOR GENERATING ELECTRIC CURRENTS;

N. Tesla, New York, N. Y. Application filed Aug. 2, 1893. The combination with discharge points immersed in oil of a conductor adapted to periodically bridge the space between such points.

514,170. INCANDESCENT ELECTRIC LIGHT; N. Tesla, New York, N. Y. Application filed Jan. 2, 1892. The combination of an exhausted globe, a refractory light-giving body therein, a conductor leading into the globe and connected to or supporting the body, and a conducting screen surrounding the conductor.

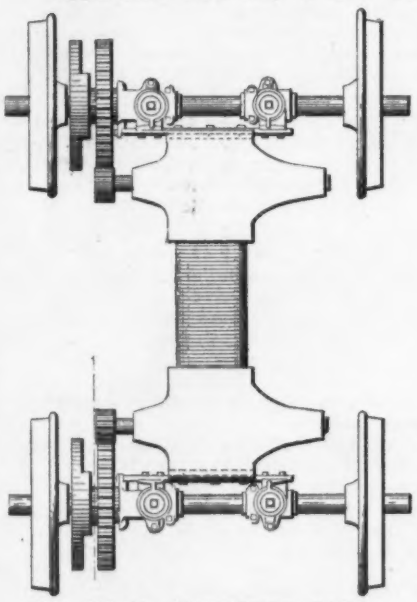
514,202. ELECTRIC ALARM; F. Sauer and C. Hentzschel, Berlin, Germany. Application filed July 8, 1893. This consists of a spring pressed lever normally kept out of contact with the two poles of an electric circuit by a bolt of a lock when the latter is in position in the striking plate.

514,212. ELECTRIC SIGNALING DEVICE; J. N. Connolly, New York, N. Y. Application filed Nov. 9, 1893. This consists of a box upon which is mounted signaling apparatus, provided on one side with an opening to receive the centre post of a bell-pulling outfit and means for locking the box in position on the post.

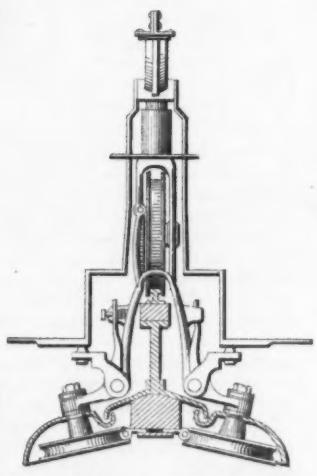
514,221. INSULATOR; L. B. Gray, Boston, Mass. Application filed June 22, 1893. This comprises a main section having a petticoat and shoulder, and a supplemental section entering the recess formed by the petticoat and abutting against the shoulder.

514,228. ELECTRICAL TRANSMISSION OF POWER; R. M. Hunter, Philadelphia, Pa. Application filed Nov. 18, 1889. This comprises a generator of alternately increasing and diminishing potential, line circuits, a secondary coil having its fine wire coil in a local circuit, a movable soft iron core for the coil, and means to insert or remove the same.

514,229. ELECTRIC ARC LAMP; R. M. Hunter, Philadelphia, Pa. Application filed May 9, 1893. This comprises a frame having



NO. 514,109.—ELECTRIC CAR TRUCK.



NO. 514,274.—ELECTRIC TROLLEY WHEEL SHIELD.

tubular guides, supporting rods guided therein and carrying at one end a condenser lens, means to adjust the guide rods upon the tubular guides, and a lamp proper supported upon the frame and adapted to produce an arc at a fixed distance from the condenser.

514,241. MAGNETO ELECTRIC MACHINE; A. J. Potter, New Hartford, N. Y. Application filed June 15, 1893. This comprises a rotating shaft and vibratory pinion engaging with another pinion fixed to the shaft and connected with an operating switching plate moved by the forward rotation of the shaft.

514,258. TEMPERATURE COMPENSATING DEVICE; W. H. Bristol, Hoboken, N. J. Application filed Oct. 31, 1893. The combination with a resistance of a thermometer and a metallic device secured thereto and arranged in contact with the resistance for varying the length of the resistance wire.

514,260. SECONDARY BATTERY; H. H. Carpenter, St. Louis, Mo. Application filed Dec. 21, 1892. This consists of a bare copper wire located in a lead pipe, the pipe being devoid of active material and having one of its ends sealed to prevent entrance of the electrolytic fluid, and the pipe being coiled.

514,267. ELECTRODE FOR SECONDARY BATTERIES; J. Legay and L. Legay, Levallois, France. Application filed Oct. 13, 1890. An electrode composed of spirally twisted wires twisted together in the form of a cable.

514,274. ELECTRIC TROLLEY WHEEL SHIELD; H. S. Pruyn, Hoosick Falls, N. Y. Application filed May 10, 1893. A trolley wheel provided with a guttered shield.

514,279. AUXILIARY FIRE ALARM TELEGRAPH; J. Sachs, New York, N. Y. Application filed April 20, 1893. The combination with a main and a duplicate or auxiliary signal mechanism of a small wire in an electric circuit to prevent the duplicate mechanism from operating until released by the melting of a small iwre.

514,297. SIGNALING APPARATUS; E. R. Wilder, New York, N. Y. Application filed May 1, 1893. A signal tape having the signals embossed therein, in combination with a circuit closer moved by contact with the embossed surface and a bolster to hold up the embossed portions while acting on the circuit closer.

514,301. RHESOTAT; J. T. Birch, Pittsburgh, Pa. Application filed Nov. 16, 1893. The combination of two rotatable wire helices, the members of the coils of the helices being insulated from each other, and a contact plate movable along the helices while in electrical contact therewith.

514,303. SERIES ELECTRIC RAILWAY; M. A. Cattori, Rome, Italy. Application filed May 18, 1893. This comprises a movable conducting piece located at the point of intersection of the tracks and adapted to be brought in line with the conductor of either track, electric connections between the opposite sections of each conductor adjacent to the crossing point and means for electrically connecting the movable conducting piece with that conductor, which is brought in line.

514,304. INSULATED PIPE COUPLING; E. E. Clift, Philadelphia. Pa. Application filed Oct. 10, 1892. This comprises a casing, a block of non-conducting material therein, an electrolier, a threaded stem thereon extending up through the block, a nut on the stem resting in a recess in the block, with cement between the walls of the recess and the nut.

514,305. ELECTROLIER; E. E. Clift, Philadelphia, Pa. Application filed July 1, 1891. This comprises a coupling having a slot therein, a wire, spring arms adapted to the wire, and a sleeve having a struck-up piece securing the arms to the wire.

514,325. INSTRUMENT FOR MEASURING AND REGULATING ELECTRICAL RESISTANCES; G. B. Lawrason, New Orleans, La. Application filed June 13, 1893. This comprises a rotatable non-conducting cylinder and a conducting rod composed of two aligned but insulated parts.

514,353. TROLLEY WIRE SHIELD; L. Eschner, Philadelphia, Pa. Application filed April 30, 1892. This comprises an open bottomed shield inclosing the conductor, and having mounted on its inside an insulating block supporting the conductor, and a feed wire also supported on the insulating block.

514,361. AUTOMATIC ELECTRIC FIRE ALARM; W. A. Guthrie, Durham, N. C. Application filed Aug. 19, 1893. This comprises a weight suspended by a wire of fusible alloy adapted to fall and make contact with a plate to complete an electric circuit when the wire is melted.

514,362. FIRE ALARM AND SPRINKLER; W. A. Guthrie, Durham, N. C. Application filed Oct. 17, 1893. This comprises a sprinkler cock controlled by a lever suspended by a fusible wire and adapted to open the cock and ring an electric bell when the wire is melted.

514,398. ELECTRIC SIGNALING APPARATUS FOR RAILWAYS; E. C. Wiley, Bristol, Tenn. Application filed May 11, 1893. This comprises a housing having lugs and contacts within the same, and a rail plate with an adjustable flange and lugs.

514,417. GLOBE HOLDER FOR ARC LAMPS; J. T. Dempster, Summit, N. J. Application filed Feb. 13, 1893. The combination with the lower lamp frame, provided with a projection, a globe holder provided with a longitudinal groove to co-operate with the projection, and a clamping screw to clamp the globe holder in any desired position.

514,425. ELECTRIC ARC LAMP; W. B. Luce, Brooklyn, N. Y. Application filed March 16, 1893. This comprises a rotary friction part, operatively connected with the upper carbon, a brake to act on the same, a solenoid in shunt circuit having a core which coacts with the brake, an electric magnet in the main circuit, an armature for the magnet normally held away from the same and coacting with the brake device, whereby the brake is held off the rotary part and a lower carbon connected with the armature.

514,429. REGULATOR FOR ELECTRIC MOTORS; S. H. Short, Cleveland, Ohio. Application filed Jan. 26, 1891. The combination with the axles of a car of a multipolar motor connected with each axle, of two commutating switches for connecting the coils of different field magnets in multiple or in series, the switches being inclosed in separate casings and insulated from each other, and a pulley applied to the insulated connection for simultaneously actuating both switches.

U. S. PATENTS EXPIRED JAN. 30, 1894.

186,755. MAGNETIC HOLDERS FOR FEEDING SCREW AND OTHER BLANKS; E. E. Quinby, Orange, N. J. Filed Oct. 20, 1876. This comprises a magnet and a divided armature and a detachable clamp for the purpose of mechanically maintaining the contact of the poles of the magnet with the soft iron pieces composing the divided armature.

186,787. ELECTRIC TELEGRAPHY; A. G. Bell, Boston, Mass. Filed Jan. 15, 1877. In a system of electric telegraphy or telephony, consisting of transmitting and receiving instruments united upon an electric circuit, the production in the armature of each receiving instrument of any given motion by subjecting said armature to an attraction varying in intensity, however such variation may be produced in the magnet, and hence I claim the production of any given sound or sounds from the armature of the receiving instrument, by subjecting said armature to an attraction varying in intensity, in such manner as to throw the armature into that form of vibration that characterizes the given sound or sounds.

186,887. FIRE AND POLICE ALARM SIGNAL APPARATUS; C. Selden, Cincinnati, Ohio. Filed May 26, 1876. This comprises a loop circuit and a secondary battery, a resistance and bell relay, the whole connected together.